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The California Journal of Elementary Education is published quarterly in August, November, February, and May by the California State Department of Education. It is distributed without charge to school officials in California primarily concerned with the administration and supervision of elementary education and to institutions engaged in the training of teachers for the elementary school. To others the subscription price is $1.00 a year; the price for single copies is 30 cents. Subscriptions should be sent to the Bureau of Textbooks and Publications.

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EDITORIAL COMMENT AND NEWS NOTES

Helen Heffernan Scholarships

Applications must be received not later than March 1, 1953, for two Helen Heffernan scholarships to be given by the California School Supervisors Association. The scholarships have been established by the association in recognition of Miss Heffernan's leadership in education. The purposes are to recruit qualified persons into the field of supervision and to encourage supervisors to engage in graduate study.

Each of the two scholarships consists of a gift of $300 to be awarded annually and a loan not to exceed $1,000 to be available in addition to the gift. The loan is to be paid back without interest over a four-year period.

Full-time graduate students or persons contemplating graduate work who are interested in applying for these scholarships should write for application forms to Ruth Overfield, Secretary, California School Supervisors Association, c/o County Superintendent of Schools, Susanville, California.

Scholarships and Loans for 1953-54 Offered by California Congress of Parents and Teachers

California Congress of Parents and Teachers has allocated $32,400 for scholarships and fellowships for 1953-54. Funds for these projects as well as for its current $60,000 student loan program come from the sale of honorary life memberships among the local parent-teacher association units in the state now numbering almost three thousand.

Requests for information about scholarships, fellowships, and loans may be secured by addressing the state headquarters of the California Congress of Parents and Teachers, Inc., 322 West 21st St., Los Angeles 7, California. Available are the following scholarships, fellowships, and loans:

International Relations Fellowships. Four fellowships of $1,000 each for study in the United States in the field of international relations and one fellowship of $2,000 for study abroad in this field are offered for 1953-54. The five candidates

for these awards are chosen by a state-wide committee from a list of candidates selected by nominating boards in each college or university in California. These fellowships carry a commitment to serve for at least one year of the three immediately following the completion of the course of study for which they are granted in the international relations branch of the United States Government or in some comparable field of public service.

School and Children's Librarian Fellowships. To attract qualified people into the field of library work for children, two fellowships of $1,000 each are offered for library students willing to specialize in work with children—one at University of California, Berkeley, and one at the University of Southern California.

Counseling and Guidance Scholarships for Summer, 1953. Twenty scholarships of $150 each are available to teachers for summer study in the field of counseling and guidance. These awards are limited to teachers already employed half-time or more in school counseling and guidance and acceptance involves a commitment to serve for one year in this field in the public schools of California immediately following the summer study. Application blanks may be secured *after January 1, 1953,* by addressing the state headquarters of the Congress at 322 West 21st St., Los Angeles 7, California.

Nursing Scholarships. Forty-two scholarships of $100 each are available to financially needy and highly qualified student nurses through the 42 accredited schools of nursing in California.

Special-Education Fellowships and Loans. Ten special-education fellowships of $1,000 each are offered for graduate study in any field of teaching mentally or physically handicapped children. Recipients must have prerequisites which will permit them to secure, at the completion of a year's work of approximately 30 semester units, a teaching credential in the chosen field of special education. They must also agree to teach in this field for two years following completion of the study.

Ten loans of $100 each, financed from the Annie Bean Fund, are available for summer study in the field of teaching deaf or hard-of-hearing children. These loans are to be repaid during the school year following the summer study.

Teacher-Education Scholarships. Twenty-four teacher-education scholarships of $300 each are available for students in training for work in the public elementary schools of California. These scholarship awards are granted at the discretion of authorized administrators in the nine state colleges of California, the University of California, and the following private teacher-education institutions: University of Southern California, Whittier College, Occidental College, and College of the Pacific. Awards are limited to students at the junior, senior, or graduate levels and may be divided between two students.

Student Loans. The sum of $60,000 was allocated for loans to students in 1952-53. This is the largest amount offered for any one year since the establishment of the loan project more than 25 years ago. Loans are available in the amount of $300 per year, payable at the rate of $150 per semester, up to a total of $1,200 for four years. Loans are made without interest, for educational purposes only, and are to be repaid within a period of four years from the close of the period for which they were made.

Guide for Soil and Water Conservation

A 48-page bulletin entitled *Know California's Land: A Land Capability Guide for Soil and Water Conservation* has been issued jointly by the California Department of Natural Resources and the Soil Conservation Service of the United States Department of Agriculture. Leonard R. Wohletz, State Soil Scientist for the federal Soil Conservation Service, and Edward F. Dolder, Chief of Conservation Education, California Department of Natural Resources, are the authors.

The publication is designed to be useful to farmers, stockmen, forest land owners, secondary schools, teachers in elementary schools, planning commissions, conservation organizations, and governmental agencies dealing with soil and water conservation. It contains 76 illustrations and is accompanied by an 8-color map of California, 42 x 58 inches in two sections, which shows in general the distribution of the eight land classes in the state.

The subject matter of the bulletin includes facts about California's land, description of the eight classes of land according to suitability for use, conservation practices, and uses recommended for each class, and physical descriptions of eight major watersheds of California. The bulletin may be ordered from the Documents section, State Printing Division, 11th and O Streets, Sacramento, at $1.03 per copy.

SCIENCE FOR EVERY CHILD

ADRIAN N. GENTRY, *General Elementary School Co-ordinator, San Diego County*

Do you teach young children? If so, you teach them science; you can't get away from it. Science is the study of the environment. Children have many questions about their environment. You as their teacher are called upon every day to help them find answers to these questions.

Primary children frequently ask questions such as: What makes a shadow? Why do some things float and others sink? What makes plants grow? Where do babies come from? Why do I have to drink my milk? Why does the grasshopper spit tobacco? What makes frost?

Children in the intermediate grades like to collect things they find in their environment, ask questions about them, observe the behavior of the living things, and read about the things they collect and those they observe. They frequently ask questions such as: What makes the thermostat work? What kind of rock is this? What is fire? What bird made this nest? What does my white rat like to eat? What makes an airplane stay up in the air? How does a telephone work? The elementary school teacher is thus faced with the problem of determining what science shall be taught and how it shall be taught.

Many statements of the objectives of science teaching in the elementary school have been formulated. The members of the Elementary Science Curriculum Committee of the Stockton Public Schools, for example, recently worked out the following objectives for their schools.

A good science program will

1. Keep alive the normal curiosity of children
2. Make use of children's interests and open new avenues of interest
3. Help children to develop scientific attitudes
4. Help children increase their ability to do problem-solving
5. Build understandings of those generalizations essential to interpretation of children's environment
6. Improve proficiency in ways of working, reading, recording, computing, observing, experimenting

From all indications, there is a current upsurge of interest in science education in the elementary schools of California. And considerable evi-

dence indicates that the quality of instruction in elementary school science is improving. This is particularly true in the areas of problem-solving and of scientific attitudes. Teachers are getting away from the idea that they must provide pupils with the answers to all their questions and are teaching them to solve their own problems. But the question of what science to teach has not been completely answered. In general, however, the science experiences provided pupils in the elementary schools of California fall into three categories. Many schools are attempting to provide science experiences as an integral part of the social studies units. In others, a developmental sequence of science concepts and attitudes is built up by means of units in which the main emphasis is on science experiences. The third category of science activities employed is often referred to as "incidental science." "On the spot science" might be a more descriptive term in this case, since it results from a pupil bringing a plant or an animal into the classroom, or from any of the many educationally significant problems which arise from time to time that are not closely related to the work at hand.

Teachers want to provide rich science experiences for their pupils but some do not know exactly where to begin. It is the purpose of this article to describe how certain teachers in California schools are solving the problem of what science to teach and how to teach it. Teachers are urged to try out in their classrooms the ideas presented.

Science as an Integral Part of Social Studies Units

The social studies, as defined in *The Social Studies Program for the Public Schools of California,* are those studies that provide understandings of the physical environment and its effects upon man's ways of living, of the basic needs of man and the activities in which he engages to meet his needs, and of the institutions man has developed to perpetuate his way of life.[1] The scope of social studies units under this broad definition includes the social sciences, the natural sciences, and the arts.

Primary Grade Units

Experiences involving the home, school, and community, including how basic human needs for food, clothing, shelter, transportation, and communication are met, are recommended for primary grades. These areas are all rich in possibilities for science experiences and concepts

[1] *The Social Studies Program for the Public Schools of California.* Bulletin of the California State Department of Education, Vol. XVII, No. 4, August, 1948. Sacramento: California State Department of Education, 1948.

The examples which follow were selected from a large number of descriptions contributed by primary teachers from areas widely scattered throughout California.

The Farm

Mrs. Marjorie Pursel, the teacher of the first grade in La Canada Elementary School, reported a science experience that developed while the children were studying the farm. Her report follows.

> We decided to have a setting hen with eggs. We installed a box filled with straw in our animal cage for the hen to use as a nest. We kept a daily account of the progress of our experiment. Three weeks seemed a long time to wait. In this time we learned about different breeds of chickens, what they ate, where the food came from. From a little book titled *Egg to Chick* [2] we obtained information regarding what was taking place inside the eggs.

Following are some excerpts from the daily record that was kept. The record for each day was written by Mrs. Pursel on a large sheet of newsprint according to the children's dictation. Each day's record was illustrated by the children.

April 10
We have a hen.
She is broody.
She wants to sit on eggs.

April 12
We put 12 eggs on the nest.
Our hen's name is Sweetie.

April 14
Sweetie keeps the eggs warm.
A little chick is growing in the egg.
This chick is called an embryo.

April 18
Jimmy saw Sweetie turn the eggs.
She keeps them warm all over.

April 19
The embryo is one inch long now.
It has no feathers yet.

May 4
The chicks came outside today.
We have 11 chicks.
One did not hatch.
We opened the egg.
The embryo had feathers.

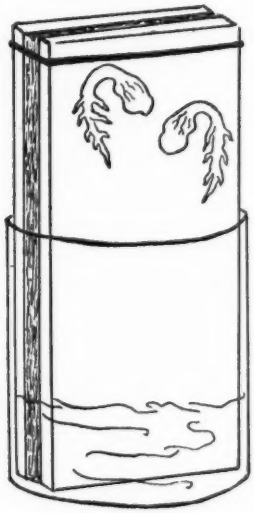
[2] Millicent Selsam. *Egg to Chick*. New York 16: International Publishers Company, Inc., 1946.

May 5

We gave our chicks mash to eat.
They drink water too.
They run around and around.

A farm unit also provided many interesting science experiences for the pupils of Mrs. Janet Fildew's third grade at Lincoln School, Pasadena. Mrs. Fildew outlines these experiences as follows:

We planted lima bean seeds in three small flower pots, one of which was filled with sand, one with loam, and one with adobe. We noticed that those placed in sand came up first, but those planted in loam developed into the biggest and strongest plants. The ones planted in adobe did not even sprout. We observed while watering the seeds that water went through the sand quickly and that the adobe could absorb little water.



Seed germination experiment

Seed germination, root structure, and rapidity of growth were observed by putting lima beans on a piece of blotting paper and then placing the blotter between two plates of glass and tying them together. The glass was placed in a tumbler containing a small amount of water. It was exciting to watch the blotting paper absorb the water, and the seeds sprout into tiny shoots and roots. Then as the first plant food supply which was stored in the seed became exhausted, we saw the little plants wither and die because there was no food material in the water.

We placed a white flower in a glass containing water with red coloring in it, and watched the flower turn pink, demonstrating one function of stems.

The leaves of our philodendron plants were a rich beautiful green. We pinned paper around some of the leaves to see if the light was really necessary. After several days the covered leaves turned yellow. One of our bean seedlings was placed in the dark supply closet, and although properly watered, it turned yellow and withered.

Many experience charts were developed from our science activities.

Interest in animals started with a trip to the dairy where we saw Holstein and Guernsey cows. The children enjoyed collecting pictures of many breeds of cattle. They wrote simple stories and original rhymes and painted pictures to illustrate them.

Our discussion and research on the things that help the farmer and the things that make his job hard led into a study of the common insects found in rural areas as well as in towns. We built insect cages so that we could observe the feeding habits of crickets, ladybugs, locusts, and grasshoppers. One child brought a piece of honeycomb to show the class, and an interesting discussion of bees followed. We enjoyed listening to the record "Why Are Bees So Busy?" We made a reading chart on how the honeybee helps the farmer. Our terrarium served many purposes, but the most interesting was the work of the earthworms and the discussions about their beneficial effects in aerating the soil.

An opportunity for the first graders of Pomerado School in San Diego County to solve a problem by experimentation arose during their study of the dairy farm. The children, under the direction of their teacher Victoria Tassell, planted some alfalfa, barley, and oats. Birds came and ate the barley and oat seeds. Again the seeds were planted with no better results. The children had heard stories about scarecrows and wondered if they could make one which would work. It sounded like fun. One child said it would not work. He had helped his parents with gardens and the birds came and ate everything in spite of the scarecrows. Other children thought it would be a good idea to make a scarecrow because it always worked in stories. A scarecrow was constructed and set up in the garden. For a few days, the birds were frightened when the wind blew the clothing. After that, they were not afraid. They ate the seeds. Someone suggested that strings with rags attached to them be fastened on the scarecrow. For a time this worked and then the birds returned. During all this experimenting, food and water had been provided for the birds some distance from the garden. The children learned from actual experience that their scarecrow was not effective. They also learned that sparrows and linnets were the most persistent destroyers of seeds. Their experience led the children into a study of birds harmful and useful to the farmer.

Our Neighborhood

Mrs. Helen Rounds, kindergarten teacher, Field School, Pasadena, reports on the following science experiences of young children.

> Much of the work in the field of science for kindergarten and the primary grades is an outgrowth of children's natural interest in animals.
>
> The animal study project was initiated for the children in the kindergarten by a study trip to the zoo, but children in all the grades participated in the work of building shelters and caring for the animals which were raised at the school. The children learned the proper kinds of food and methods of feeding as well as the habitat and characteristics of the animals. They learned conservation through visual education and firsthand experiences. They developed rhythms, murals, stories, songs, and made clay animals. The children quickly learned to recognize the birds commonly seen in the immediate neighborhood, and some of them even learned to identify a few bird songs. They observed the life cycle of insects with intense excitement. A first-grade child became so interested that he prepared an ant colony exhibit at home, using a mayonnaise jar and black construction paper.
>
> Our study of plant life began with the gardens we planted, both in the classrooms and out-of-doors. We planted grass seed on wet cotton to watch root development and planted bulbs in bowls of pebbles to watch growth. We collected seeds, beginning with those from the jack-o-lantern pumpkin, to learn about the different methods of seed dispersal. When the vegetable garden was ready to harvest, we learned which parts of plants are edible, and how they are prepared for food.

Conservation

The rapid postwar growth in California has emphasized the importance of conservation education. The Subcommittee on Conservation Education of the California Committee for the Study of Education has recommended that the teaching of conservation be carried on actively at all levels and in various subject-matter fields of the curriculum.[3] In the elementary schools an imaginative teacher can find opportunities to develop concepts and attitudes regarding conservation and wise use of natural and human resources in connection with social studies units. The following examples illustrate how conservation education may begin in the first grade and be carried on throughout the elementary school.

The first grade children of Encinitas Elementary School were studying soil and its importance in producing food. This is how their teacher, Mrs. Andre Gendron, described some of the science and conservation experiences which were included in this unit.

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[3] *Guidebook for Conservation Education.* Sacramento: State of California Department of Natural Resources in Co-operation with Department of Education, March, 1950.

The first day, as a prelude to "What is Soil?" we talked about our world, the earth. For background I told the story, simply, of how the earth was made. Believe it or not, I have never had more enraptured attention.

We talked about the solid rock formation, the rain falling into cracks, and freezing in winter, breaking the rocks open. The effects of earthquakes and the receding of the oceans were also discussed.

We put bottles of water in the school refrigerator to freeze and break the glass in order to illustrate the action of water freezing in rock crevices.

We saw a fine example of "layer" formation of rocks on a highway near the school. Shells we found imbedded in a ledge about a mile inland from the ocean were brought in for observation.

We took a field trip to the beach and saw the breakers pounding against the rocks, and saw the many small rocks lying about which were already broken off large rocks and which were being worn down by the waves. We saw the sand as being made up of tiny rocks.

Fertilization of the soil was discussed. The children told about the compost piles in their gardens. Several volunteered information about animal fertilizer. The field across the road had just been covered with manure.

In the woods we saw leaves and vegetation of all sorts dying and forming their own carpet of compost. We learned the word *humus*.

The members of the class wanted to make soil. They could, and did. They brought rocks and pounded them into bits, they brought clay from the clay banks, decayed vegetable and animal matter—mixed and pulverized all. And lo, a miracle had happened; we had made soil! The children's enthusiasm was boundless. Was it real? Would seeds grow in it? To answer these questions, we put some of the *soil* into flower pots and planted seeds in it. We also planted a geranium slip—both the seeds and slip grew.

We spoke of the time, effort, and hard work it had cost us to make good soil, and from this came an appreciation and respect for the time that had gone into the making of the thin layer of soil that is the earth's crust.

With realization of all this came the urge to hold on to the soil and not waste it. This was conservation. We did not want to see our school ground soil washed away. We went out and made our own small gully plug in one of the ditches in the schoolyard.

Where the steep banks were terraced, we saw the growth of succulent plants, and in exposed places we could see the roots, twisting and interlaced, holding the soil in place.

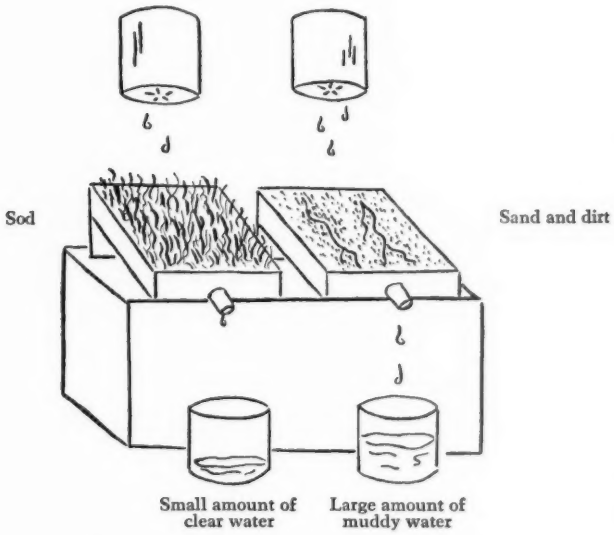
By this time the activity was an understanding and a learning one. We were ready to appreciate the film, "What is Soil?" We had experienced it.

Dorothy Lyon teaches in the upper grades of Davidson School in San Bernardino. At the beginning of each school year she organizes her class into a nature club. Some years the group chooses to affiliate with the Junior Audubon Clubs; other years they choose to remain a local organization. A carefully planned program is followed, starting with conservation, its meaning and necessity. All phases of conservation that are mean-

ingful to children of the ten to twelve-year-old age group are investigated and discussed. After the group understands the meaning of and the need for conserving our natural resources, they take up the subunits, soil, water, swamps and marshes, grasslands, and forests.

Under each topic a study within the range of interest of the children is made of the things that live in and on the area under consideration. By the time the subunits on conservation are completed, the children are well aware of the natural world around them, not only as a thing of beauty, but as a necessary part of man's environment.

The children perform many experiments. One that always holds their interest is the demonstration of the effect of water runoff in different types of soils. Two shallow boxes are placed side by side on a table. One is filled with sod, the other with sand and garden dirt. The boxes, elevated at one end, are then sprinkled with a measured amount of water. The children observe the runoff water which is collected in jars. They check this runoff as to rate of flow and clarity of the water. When the



Demonstration of the effect of water runoff in different types of soil

experiment has been performed several times, they note erosion in the sand box. Next they experiment in this box with check dams and small plants to see how they can check the damage caused by the rapid runoff.

A conservation bulletin board is used by Harriett Paterson to introduce the study of conservation to her sixth grade children. Under a title, "America's Wealth and Beauty," are placed colorful pictures of our natural resources—forests, farmlands, lakes, wildlife, and minerals. The lower half of the board is titled, "Use Without Waste." The pictures on this part show flood control, reforestation, strip farming, and a bird sanctuary. The children are encouraged to look for similar pictures and for articles about conservation to replace those on the bulletin board. The pictures which children collect are also used to illustrate written reports or creative writing on the subject of conservation.

Intermediate Grade Units

Of the social studies units suggested for use in intermediate grades, those on California, the Westward Movement, Aeronautics, and Communication provide the greatest opportunity for integrated science experiences.

California

Rosalie Gotfredson, fourth-grade teacher at Fletcher Drive School in Los Angeles, makes use of her hobby of collecting minerals in the following manner while teaching a unit on California.

> In discussing the minerals in the classroom, the simplest way of tying them into the study of California is by finding on a large California map the locality of the origin of each mineral. If the minerals of the Mother Lode country are used, they can even serve as an introduction to the history of California. Many of California's minerals are of great commercial importance. A satisfying subunit can be built around one of our common kitchen necessities, table salt.

The fourth-grade pupils of Edna Taggart at Longfellow School, Pasadena, begin to study rocks and minerals when they are learning about the California Gold Rush. For some of the children this is the beginning of a hobby which they continue long after they have completed the fourth grade.

While studying California, Miss Taggart's pupils also learn that the California Indians' food consisted entirely of what they could find on the land, in the rivers, and along the shore of the ocean. The class delighted in gathering the small acorns of the valley and the large ones found in the mountains. It was fun to prepare them for food as the Indians did. A brief study was made of some of the plants that were used by the Indians. The class gathered shells along the seashore and learned to

identify them. To show how the Indians obtained salt from the ocean they placed some salt water in a small pan. As the water evaporated, the salt settled on the inside of the pan.

Desert Life

Mrs. Isabel Wallace of Emory School in Palm City describes in a graphic manner how her attempt to enrich a unit on desert life for her sixth-grade pupils developed into a fullfledged study of the flora and fauna of their community.

At the beginning of this school year, if you had asked the pupils in my sixth grade class to pick up an insect or a lizard, they probably would have told you in no uncertain terms that they were not interested. Now, I have difficulty in keeping up with their enthusiasm and interest, and wonder what I did for excitement in the old peaceful days.

During the study of a unit on desert life, we discovered that most of the small life in San Diego County is typical of desert life, and we decided to see what we could bring to class to illustrate this fact. Our collection soon included a scorpion, centipede, toad, snake, praying mantis, numerous kinds of roaches and other insects, several black widow spiders, a tarantula, and trapdoor spiders.

Our collection was first housed in jars, bottles, and "what have you," but my husband, whose soul delights in orderliness, took pity on us, and after a few evenings of work in his shop came forth with two long glass cases. All four sides and the partitions are of glass, with the screen door and window on top. He also made us a large case with solid back and a small one for the trapdoor spiders.

Three shelves, each fourteen feet in length were built along one side of the room to display the specimens. The shelves were built under the supervision of the County Mobile Shop Unit, but were planned and executed by the pupils.

In addition to learning how to collect and house specimens, the children eagerly digest factual data which pertains to the care and feeding of such pets. We find that during pleasure reading period the beautifully illustrated nature study books are in first demand, and current events reporters bring in many interesting stories from nature. A field trip during the year to see what flora and fauna we had in our own back yard was a high adventure.

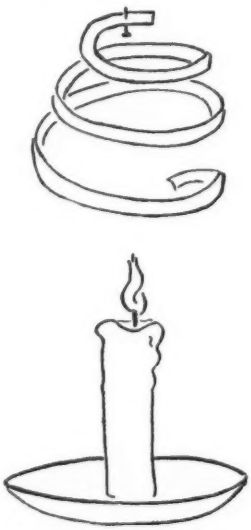
Our room is a gathering place for all "bug-minded" youngsters in the school. We have played host to parents and to members of the community. Several of our experts were always ready to describe the life and habits of the different specimens. This has been a valuable lesson in gathering and organizing material and in oral presentation.

Our science collection has provided the rich and satisfying blend of life and color which contributes to the kind of stimulating environment in which hobbies and children thrive.

Aviation

The unit on Aviation is extremely popular with most sixth-grade pupils. This unit also makes possible many science demonstrations and experiments. After children have learned why men fly, they want to know how they fly. To understand this, they need to be taught basic concepts of air. The demonstrations which are described below are used by Dorothy Lyon of Davidson School, San Bernardino, to show that air takes up space, has motion, and has weight.

To show that air takes up space we have the children burn a candle in a dish of water over which a jar is inverted. They note the water rises up around the candle as soon as the flame, having burned up the oxygen in the jar, goes out.



Demonstration showing that warm air rises

To show that air has motion and that warm air rises, the children cut a spiral of paper and hold this spiral over a burning candle. The spiral will spin due to the convection.

To demonstrate that air has pressure the children fill a glass with water and place a heavy piece of paper over the top. They hold one hand on the paper and invert the glass. After inverting, they remove the hand from the paper, holding the glass in the other hand, and the water will remain in the glass. The least disturbance of the paper and the water will run out. It should be explained that the water is pressing down on the paper, but that the air is pressing up with a greater force and thus the paper remains in place.

Hundreds of children in the elementary schools in San Diego County have been enjoying the time of their lives while studying aviation and the aviation industry. Hildegarde Hartig, Science Co-ordinator for the office of the San Diego County Superintendent of Schools, has developed a plan whereby the children are taken on a trip through the airport which culminates in a half-hour flight in a large commercial airliner over San Diego and their own communities.

Ninety per cent of the parents have given permission for their children to take these flights for which the airline company charges only a nominal fee.

Before the flight is taken the children are informed regarding the things they should observe while they are flying. After touring the airport they board the plane and are introduced to the crew. They then fasten their safety belts, and follow the rules of a regular flight. Contrary to usual practice, the door to the cockpit is fastened open so that the pupils can come up and inspect the maze of instruments facing the pilot.

Every child is given a colorful air-field-trip guide. This guide includes photographs of various parts of the interior of the plane, statistics about the plane, a diagram of the exterior with spaces to label the important parts, spaces to fill in the names of the crew members and takeoff information, a map of San Diego County on which the flight may be traced, and space to write highlights of the trip. There is also space for the children to write questions that they would like to have answered after the plane has landed.

Miss Hartig points out that in the flight the children gain a conception of global geography that would be difficult to learn from books and that they also change their ideas about space and time. Their writing facility improves with the addition of new words to their vocabulary and maps take on a new meaning. They learn to think that it is fun to work with figures in computing gas consumption and mileage. The children also learn how to look up information that they need. In their schoolrooms they are eager to experiment with aerial drawings and sketches of airplanes. They build simple weather instruments. Air pressure and wind velocity become more than academic terms.

Upper-Grade Units

Science in grades seven and eight is often taught as a separate subject. But certain small schools and a growing number of large schools that are developing core curriculums continue the use of social studies-science units in the upper grades.

The Laws by Which We Live

While studying the Magna Carta, the Constitution, and other great documents which govern our lives and guarantee our rights, Mrs. Rhea Gibson's eighth-grade class at El Cajon School decided to find out something about the natural laws of the universe which also govern the life of man. This led to an astronomer being invited to speak to the class and to conduct a night study trip so that the girls and boys could observe the moon and certain of the planets. The members of the class worked out a nutritionally balanced meal and served it as a pot-luck dinner before the trip was begun.

The laws of nature which control the lives of plants and animals were also studied. Protective coloration is a good example of the things studied.

Democracy in Action

Mary Brennan, eighth grade teacher at Lowell Joint School District, Los Angeles County, describes how she has been able to teach groups of problem boys, as a result of their interest in science and construction of simple science equipment, that service is a duty of citizens in a democracy.

> Three years ago, I had a group of boys who were rather serious discipline problems. They needed something to do with their hands, they needed something to be really interested in, so I decided to find something for them to do while the girls were sewing.
>
> Science seemed to interest the boys, so we prepared simple, homemade equipment to carry on experiments with electricity, weather, and conservation.
>
> The following year we added to the equipment, and since an important duty of citizens in a democracy is service to others, we began to make equipment for the school. We obtained a bookcase from the library, put books on one shelf and equipment we had made on another. The boys kept the shelves in order, labeled and dusted them. Teachers use the equipment when they have need for doing so.
>
> We made cages, scales, stargazer, aquariums, test tube holders, and, out of money we earned baby sitting for mothers on Parent Teacher Association meeting days, bought equipment we couldn't make.
>
> Whenever a room needs help on some problem, the group usually calls on the eighth-grade boys to help solve its problems.

Science Units and On-the-Spot Science Experiences

According to one school of thought the social studies framework in actual practice does not always permit inclusion of a developmental sequence of science concepts and activities. Although some of the present

social studies units are rich in science possibilities, others are not. A danger exists that important concepts in some areas of science will be overlooked.

The following quotation from "A Tentative Statement Pertaining to the Teaching of Science in the Elementary School," by the Science Steering Committee of the Stockton elementary schools presents one point of view on this problem.

> We should not rely entirely on getting "leads" from social studies or language arts for a science program. Neither can we depend entirely upon "incidental" science. Science concepts must be developed in some kind of sequential pattern if they are to become meaningful to children. This means that the teacher must do long term planning in terms of the needs and interests of pupils. Science does have a relationship with other school subjects. At times there is a natural fusion of several subject areas; and at other times it is desirable to emphasize science problems that may not be directly related to the social studies program of that grade level.

The teachers of Stockton are attempting to develop a series of science units based on the needs, problems, and interests of children at various grade levels. They also hope to achieve a balance in terms of areas of the environment. Strongly emphasized in the statement of this committee are the possibilities and techniques for teaching problem-solving.

The "Science Teaching Guides" that have been used by elementary school teachers in San Francisco since 1949 also emphasize a developmental sequence of science concepts and activities. These guides are not courses of study; they are teaching suggestions arranged so that major fields of science are touched upon at several levels in the elementary school. The suggested activities may be carried on as part of a social studies unit or during a separate period set aside for science. The purpose of this type of organization is to provide experiences in the major areas of science for children in primary grades and to build upon and to enlarge these simple concepts in the intermediate and upper grades.

For the past five years the Science Steering Committee of the San Mateo elementary schools, with the assistance of Dr. M. F. Vessel, Professor of Education, San Jose State College, has been developing a well-balanced series of science units for use in all elementary grades. These units cover such areas as weather, electricity, weeds, and social insects.

Dr. Vessel's main function is to prepare and deliver fifteen-minute radio broadcasts focused on these teacher-prepared units to be heard weekly by some 1500 elementary school pupils in the San Mateo schools. Informational outlines for each unit are prepared by teacher committees

and distributed to all elementary teachers in the system. In addition, the teachers are furnished a guide sheet one week in advance of the broadcast to tell them what the broadcast is about. The information given includes a definition of difficult words, objectives of the broadcast, references to available material, and questions which will be answered by the broadcast.

To assist in focusing attention on difficult concepts a sketch sheet or diagram is used. This is referred to during the broadcast. Each pupil receives a copy of this mimeographed worksheet. A list of suggested activities and experiments related to each unit is distributed to pupils in the upper grades. In addition, directions to teachers for making such things as terraria are provided. Three or four weeks are allowed for each unit. A pupil broadcast is presented as a culminating activity for each unit.

Science units are not always taught in a definite sequence. In fact, it is common practice for teachers to develop science units in whatever areas they wish, depending on the training and interest of the teacher or upon specific needs and interests of the class. In some cases, the unit or topic may require several weeks or even the whole year for completion; in other cases, an on the spot problem might be solved in one day.

A variety of science activities, not necessarily carried on as an integral part of the social studies-science framework, are described in the part of this article that follows.

Science for the Primary Grades

Plants and Animals

Young children, like their older brothers and sisters, are interested in the living things in their environment. They bring to school all sorts of plants and animals. Teachers often have difficulty in providing adequate care and housing for them. Furthermore, they do not always take advantage of the interest that the pupils show in these collections. The experiences of several teachers in caring for and using living things in teaching science are worthy of consideration.

Carol Wright, John Gill School, Redwood City, found exciting material in a study of spiders. She reports as follows.

> It was just luck that caused me to happen on a full grown garden spider hanging on a beautiful orb web on the last day of summer vacation. It was inspiration that helped me put it, web and all, in a gallon jug and to bring it to school on that opening day.
>
> My aims were not alone to develop a scientific interest in spiders as being useful to society. First, I wanted my second grade children to learn to use their eyes to see all of the wonderful and fascinating things that live about them.

I wanted them to know that they could bring any of these things into the classroom and have their questions respected and answered.

Next, I wanted to teach them sources of information and how to use them; second grade children can learn to use encyclopedias and reference books.

My last aim was to motivate my pupils, who were reluctant to stop vacationing. I wanted material for reading charts, language situations, and oral discussions in order to become acquainted with my new class.

We fed our spider and watched how it seized any live insect, paralyzed it and wrapped it with silk, right before our eyes. We read aloud all we could find about the spider. We counted its legs, watched its eyes, and discovered the differences between spiders and insects.

Our garden spider soon had company. We acquired a handsome tarantula, trapdoor spiders, and a black widow. The black widow was in a jar well sealed with adhesive tape, and was available only for *looking*, not handling, for we learned that the black widow alone among our native spiders can be dangerous to handle.

We put our information into words and together we wrote and read charts containing our newly acquired information.

One morning our ever co-operative garden spider had a surprise for us. She appeared much smaller in size, and at the top of the jar was a beautifully constructed egg sac. Our Spider Unit does not have a conventional windup. It is in a state of suspended animation, for we are waiting patiently for our spider eggs to hatch, and while we wait, we are enjoying starfish and hermit crabs in a dishpan of salt water, and it's almost time for the tank in which we keep our guppies to be filled with tiny baby fish.

The need for a unit on nature study for Dorothy Baker's first grade in Redwood City developed when the children brought in tadpoles, ladybugs, and spiders. They were so interested to know about them that the following unit was formed right then.

We called it "Let's Go Outdoors." A book with this title by Harriet Huntington was followed during the unit.

A nature table was in the room. At various times it contained turtles, sowbugs, worms, snails, and a trap-door spider. A library table was set up and on it were placed books about insects and their relatives.

Art is a natural in this unit. We drew each creature and made plaques from the drawings. In language, the pupils gave reports on the insects in which they were interested. Each kind of animal had a few lines written about it during the writing period. The children made up poems such as, "The turtle is sleepy, creepy and slow; But he gets there sometime, even so." The children's vocabularies were greatly enriched.

The songs for this unit were taken from *Our First Song Book.*

To culminate the unit the children invited their parents to come to see their written books and hear what they had learned about the local insects and spiders. Later, a similar unit was built around local birds.

Children of primary age like to watch plants and to discover what makes them grow. They carry out experiments to show that plants need

water, that they grow toward the light, that they grow faster when the weather is warm, and that they grow better in some soils than in others.

Field trips are taken to study the different kinds of living things around us, which are useful, which are harmful, and the like. The study of living specimens is often supplemented by the use of photography, filmstrips, and motion pictures.

Time and Shadow

An interesting and worth-while unit on this topic was developed by Mrs. Andre Gendron with the first-grade pupils at Encinitas Elementary School.

While at play on a sunny day, the children began to notice their shadows. They tried to run away from them, but found that this was not possible.

This spontaneous play was organized into dramatic play in which the children danced with their shadows. Stevenson's poem, "My Shadow," was much enjoyed.

The children wanted to know what caused shadows and learned that they resulted from light behind an object. They also learned that the position of the sun in the sky or the candle in the classroom determined where the shadow would fall and that outdoor shadows were different lengths at different times of the day. This was shown by driving a cut-off broom handle into the ground and measuring the length of its shadow in the morning, at noon, and in the afternoon. The idea of measurement with a yardstick was introduced here.

The children then discovered that they could tell time roughly by noting the position of the stick's shadow at different times of day. They dramatized a sundial. Other forms of time pieces were brought in and discussed. The children learned to tell time by using the schoolroom clock.

The group experimented with trying to tell a minute of time by holding up hands. As each child estimated that a minute had passed he lowered his hand. They were also given the idea that time is valuable and discussed ways of conserving it.

On-the-Spot Science

How several teachers developed on-the-spot science interest into science units were described in the preceding paragraphs. All sorts of opportunities like these may be utilized by the alert teacher. These ideas may develop into units or a few minutes may be devoted to a discussion

or demonstration of some scientific concept or to the solution of a simple problem which a child brings up in class.

On their way to school one morning a number of first-grade children in a San Francisco school saw a rainbow. This led to a discussion of where else they had seen rainbows, such as in a soap bubble, in the sky, in an aquarium, in a waterfall, and in a hose sprinkler. The question then arose as to why we see rainbow colors in these places. An aquarium was placed in the sun and a rainbow produced. A prism was also used for the same purpose. The concept was developed that when light is broken up it separates into a color pattern which we call a rainbow.

One of the main objectives in teaching science is to provide children experience in problem-solving. These experiences should begin in a simple way in the primary grades. Questions of the children on scientific topics often provide opportunity for problem-solving. By using this technique the teacher is often taken "off the hook" because she does not have the answer. She can solve the problem along with the pupils.

A first grade class in Stockton, for example, was discussing how firemen had extinguished a fire in their school the day before. The question arose as to what made a fire go out. One child suggested that the fire went out because it got too hot. The children talked about ways of testing this solution. They decided that out in the sunshine would be a hot place. They lighted a candle in the sun but the wind blew it out. They tried the shade. It went out again. They decided that their solution might not be correct and suggested other solutions which were tested until the right one was found.

Intermediate and Upper Grades

A Tiny World of Living Things: The Aquarium

Juanita Dow, Wilson School, San Bernardino, contributed this account:

> Is a round bowl a good home for goldfish? How much sand do we put in an aquarium? What kind of plants do we use? How do goldfish breathe? These were some of the questions asked by the fifth grade pupils when the aquarium unit was in the exploratory cycle.
>
> In initiating the unit, a center of interest was set up. In addition to the goldfish, it included pictures, books, and an aquarium. Children are by nature curious and soon questions were being asked. The room secretary wrote the questions on the board and each child copied them. From time to time, as the unit progressed, other questions were added and as answers were found the questions were crossed out. A short pretest was given in discussion form. This enabled the teacher to know the scope of knowledge of the class, avoid

repetitious facts, and made it possible for her to utilize pupils who had advanced knowledge in giving reports and demonstrations.

When the exploratory periods were completed, the actual period of learning was initiated. During this period many and varied activities were performed; preparing the aquarium, reading, reporting, experimenting, discussing, and taking a study trip.

Three levels of assignment were used to take care of individual differences. "Assignment A" or guide sheet was geared to the text; the study questions were brief and concise with a statement of the problem heading the sheet. Every pupil was required to do this assignment. Those finishing this assignment obtained "Assignment B," which consisted of research reading and other activities. The pupil was then ready to do "Assignment C," which was purely creative in nature with an opportunity for experimentation, drawing, or any number of other things related to the study.

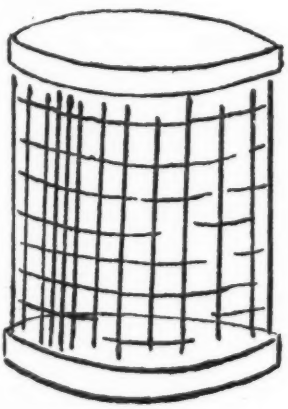
After much research, many of the questions were still unanswered, and a trip to the aquarium was arranged, letters were written, mothers were enlisted as guides, questions were distributed. When the class returned, an appraisal was conducted, and those who had questions answered were eager to make reports.

The unit was culminated with an organization of total learnings in a discussion. An objective test was used as part of the evaluation.

This unit led into further scientific study. An experiment was completed showing that water contains air. As the water in the test tube commenced to boil the problem was brought up of how heat affects matter. This formed our next unit of study.

Nature Study

The variety of activities which may grow out of the interest aroused by a science corner is pointed out by Ian Hutcheon, McKinley School, Redwood City.



An insect cage

What started out to be a small science table for fun provided learning experiences involving reading (encyclopedias, pamphlets, reports); writing (reports); arithmetic (measuring); spelling (reports); language (good usage for written and oral work, use of index, and table of contents); health (diet, sunshine, air); physical education (exercise and adequate space allow better growth); art (drawing and lettering); citizenship (voting, sharing); and basic facts of science, such as the balance of nature.

Some pupils also enjoy constructing cages for the animals. A simple insect cage may be constructed by fastening the ends of an 18 by 32-inch piece of copper screen together with staples of interwoven wire to form a cylinder. A 10-inch cake tin is placed under the wire cylinder and another on top.

Margaret Saure of Carpenter Avenue School in Studio City describes how the children in her school have developed an exhibit around the theme, Design in Nature. A unit of this sort not only provides for creative art experience but also teaches the children to observe, make new discoveries, and to develop imagination. Nature has created a wealth of design in the woods, at the seashore, and in fields and gardens, all of which supply us with material for firsthand observation and experience.

Astronomy

Mrs. Betty Mallonee, Edison School, Pasadena, tells of her fifth grade's interest in astronomy in the following account:

> A keen interest was aroused in a study of the stars when one of the boys in the fifth grade received as a gift the book, *A Dipper Full of Stars.* He brought it to school to share with the class, and the interesting text and diagrams quickly caught the fancy of several children. A few days later, another boy contributed the first volume of the *New Wonder World,* and our astronomy project was well launched. The children drew diagrams, wrote and presented reports on the sun, earth, and other planets. Pictures and articles on astronomy were mounted on the bulletin board.
>
> Later in the fall, the parents of one boy permitted him to invite five others to accompany them to the planetarium. This further stimulated interest and led others to visit the planetarium.
>
> Although the major interest in this study had started with a small group, their enthusiasm was so keen that the entire class came to have at least a cursory knowledge and interest in astronomy, which continued throughout the year.
>
> Late in the spring it was the unanimous decision of the class that the science committee chosen by the children prepare an attractive and informative display for Open House to show our friends the work which had been done in astronomy.
>
> Colored chalk was used in making a drawing of the heavens on a large section of the blackboard. Further plans involved the construction of a replica of the planetarium to be placed in front of the mural. We mixed papier-maché and molded the dome of the planetarium over a globe of the world. Trees, flowers, and a parking area were created in paper sculpture, and a telescope, miniature figures, and cars were brought from home by the children. Before our eyes, the earth and the planets took shape.
>
> After many trials and tribulations the project was finally completed to our satisfaction, and the science committee was asked to explain the wonders of the heavens to our Open House guests.

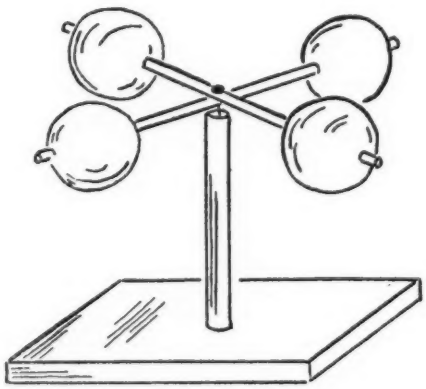
Weather

The study of weather often develops as a part of the unit on aviation. In the following example, however, it resulted from questions which were raised after a repairman had come into a fifth grade room in Stockton to repair the thermostat. The children wanted to know what a thermostat is and how it works, how it was different from a thermometer, whether it could control heat, and the like.

The following activities came after a class discussion of thermostatic heat control, thermometers, and temperature in general.

> Several pupils volunteered to look up material in the library and give special reports. A thermometer was brought to class and compared with the thermostat. The thermometer was placed high on the wall to show that heat rises. A ribbon thermometer was constructed. A simple milk bottle barometer was constructed to demonstrate changes in air pressure. Two pupils obtained a model thermostat to show the class. The class learned that thermometers measure heat while thermostats measure and control heat.

A six-week unit on Weather is used by Winston E. Roberts of Central School, Chico, to begin the semester in his eighth-grade science class. Last fall several of the pupils brought in copies of the issue of *Life Magazine* [1] which contained directions for building simple anemometers, barometers, hygrometers, and weather vanes. The class was divided into groups and each group constructed one or more of these instruments.

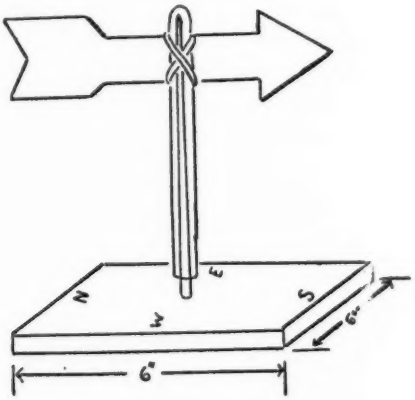


A simple anemometer

A simple anemometer (wind gauge), for example, may be constructed by cutting two table tennis balls in half. Swab sticks are then inserted through two holes drilled in each half. A ½-inch hole is drilled in the

[1] "50 Cent Weather Bureau," *Life*, XXXI (August 6, 1951), pp. 67, 68, 70.

center of the base and a ½-inch by 8-foot dowel rod glued into the hole. The swab sticks are cemented together at right angles to each other and fastened to the top of the dowel rod with a pin in such a way that the rotating arms are free moving.



A weather vane

Many types of weather vanes may be devised by the pupils. The one shown here was constructed by drilling a small hole into the center of a block of wood and driving a steel knitting needle through the hole from the bottom. A 6-inch length of glass tubing is sealed at one end in a gas flame. The arrow, cut from a 2 by 8½-inch piece of cardboard, is fastened to the glass tube with a rubber band. The cardinal compass points are marked on the base.

A field trip was taken to Southwest Airways to see how their anemometer worked, how barometric readings were taken, and how the local ceiling was determined by use of a hydrogen balloon. The pupils also visited a local naval reserve headquarters and heard radio reports of weather conditions being given to and from planes aloft.

The seventh-grade pupils of Howard Genrich of Hoover School, Merced, were also much interested in units of air, water, and weather. Both Mr. Roberts and Mr. Genrich describe a demonstration to show the great power of air pressure, which never fails to amaze those who see an example of it.

> A small amount of water is placed in a two-gallon syrup can or a five-gallon varnish can. The can is then placed on an electric hot plate until steam is formed. The can is removed from the heat, the lid is screwed tightly on the can, and cold water is then poured over it. The can is crushed entirely out of shape by the air pressure.

Science Clubs

Teachers often find that one or more of their pupils are interested in a certain phase of science, which holds no special interest for the class as a whole. The organization of a science club is one way to handle individual and small group projects. These clubs may meet during the regular school day or after school. In some cases the whole room is organized into a science club and individuals or groups are permitted to work on any phase of science that interests them.

The third and fourth grade pupils of Helen Bowen of Pomerado Union School at Poway organized a science club and carried out such experiments as evaporation of salt water and fresh water, how soil is made, and how plants grow. They also made several study trips.

The Eighth Grade Club of North Fork Union School in Mono County, sponsored by Mrs. Mary Thomason, prepared a mounted wild flower display for the Madera County Fair. The judge of the exhibits was so impressed with the display that she asked to take several of the mounts back to San Francisco to use on her television show. The group was assisted in naming the plants by a forest ranger from the Sierra National Forest. In addition to providing an interesting project for the eighth grade, the exhibit provided much favorable publicity for the school.

Summary

More and more, teachers are beginning to realize that girls and boys are frequently fascinated by science—science that is dynamic and alive, that provides opportunities for observation, problem-solving, reading colorful books, and the construction of simple scientific equipment.

Whether it is the policy of the school to teach science as part of social studies units, as sequential science units, or as a result of on-the-spot questions raised by the pupils there seems to be no doubt that girls and boys in classes such as those described are gaining valuable concepts, skills, and attitudes. The examples show what can be done, even by teachers with little background in science.

An expression of appreciation is due the teachers who took time during the busy pre-Christmas season to send in their ideas about teaching science.

SCIENCE FOR EVERY TEACHER

ADRIAN N. GENTRY, *General Elementary School Co-ordinator, San Diego County*

There are numerous reasons why many elementary teachers are afraid to teach science. Certain ones lack background because they avoided taking courses in science in high school or in college. Others remember frustrating science problems or shudder at the thought of dissecting a frog or picking up a snake. Yet the alert teacher is aware that almost all girls and boys like science. He knows that teaching social studies and language arts becomes easier if he uses children's interests in nature and physical phenomena. He wants to help pupils learn to solve problems and to develop an appreciation for the world in which they live. And he wishes to help them understand the scientific bases which underlie many current social problems.

It is the duty of every agency concerned with preservice and in-service education of elementary teachers to help eliminate teachers' fears of science by helping them to acquire the understandings and attitudes that qualify them to teach elementary school science. We cannot have "science for every child" until we provide "science for every teacher."

To find out how well California schools are filling the gaps in teachers' science backgrounds and developing feelings of security in presenting science as an integrated part of the elementary school curriculum, a questionnaire was sent to county superintendents of schools and to the curriculum departments of the larger elementary school districts. This article summarizes some of the best in-service training practices described by those who responded to the questionnaires. The reader will see from these descriptions that "science for every teacher" is already approaching reality in some areas in California.

TEACHERS, LIKE PUPILS, LEARN BY DOING

Michaelis points out that little learning takes place when children sit passively and do not understand the purposes in a given situation. He states further that group processes should be used in establishing purposes, in planning and evaluation; that as experiences are developed and

new problems arise, active participation on the part of children in all phases of problem-solving leads to greater learning.[1]

These principles apply to teachers' learning as well as that of children. Consequently, workshops and teacher committees are becoming more and more popular and are generally considered by teachers to be among the most valuable forms of in-service education. Questionnaire responses from school districts in 50 counties in California show that 60 per cent of them provided some type of science workshop experience for their elementary teachers during the past year and that in 70 per cent of these schools teacher committees were in the process of developing elementary science guidebooks, courses of study, or science material for use in classrooms.

Workshops

The time devoted to elementary science workshops sponsored by school districts and offices of county superintendents of schools in California varies from single half-day sessions to a series of short meetings held at regular intervals during the school year.

A well-organized one-day workshop was conducted by the superintendent of schools of Los Angeles County. This workshop was opened with an address by Rose Lammel of New York University. The teachers then were divided into eight interest groups that spent the rest of the morning exploring possibilities for field trips to various parts of the county or planning experiments and simple science equipment.

After luncheon the teachers assembled in grade-level groups to discuss the science program in the elementary schools of the county. A special leadership section was held for administrators and supervisors. The workshop closed following another general session in which Dr. Lammel led the discussion.

The Santa Clara County Superintendent of Schools recently held a demonstration-workshop that was popular with teachers. During this workshop a number of demonstrations were presented in a large auditorium. Teachers moved from one demonstration to another. The teachers were encouraged to perform each operation under supervision. The demonstrations represented various science fields; every one of them could be performed with simple, easily obtained equipment.

During the past year the Pasadena elementary school district conducted three workshops for elementary teachers interested in science.

[1] John U. Michaelis, *Social Studies for Children in a Democracy*. New York: Prentice-Hall, Inc., 1950, p. 93.

Three groups were organized—one for kindergarten, first and second grade teachers, another for third and fourth grade teachers, and the third for fifth and sixth grade teachers. Each group attended three meetings. A consultant was present at each meeting.

The first session was devoted to science demonstrations that could be conducted in the classroom. Interests of the group were identified at this time, and plans were made for the second session where the teachers were provided with materials to make things such as insect cages, terrariums, seed growing racks, leaf prints, and the like. The third meeting of the series culminated in a science fair that the teachers from all levels attended. Each teacher that wished to do so displayed things that he had made or the results of science activities that were classroom projects, such as a miniature planetarium, charts of growing things, and containers showing experiments with plants. The consultant asked each teacher to describe his display and to point out the contribution it made to good educational outcomes. The consultant then rounded out the meeting by demonstrating science activities dealing with such areas as air, water, and living things.

From Santa Barbara county comes an example of a science workshop for teachers from a single school. Blochman Union School is a five-teacher elementary school. The board of trustees declared a minimum schoolday once a month in order to give the teachers time to carry on the work of curriculum development.

The first goal was a clarification of the content of elementary science. This was done by open discussion. The next objective was helping the teachers see the relationship of science to basic human needs. At this point the teachers pointed out that (1) the content of science deals with man's relationship to his environment; and (2) the content of the social studies deals with man's relationship to both his environment and to people in meeting his basic needs.

The teachers concluded that science is an integral part of the social studies program in the elementary school. They then discussed science as a method and developed an outline of the scientific method for attacking problems. They decided that if learning experiences are to be alive with meaning for children, problem-solving is the approach to use.

Time was also set aside to share and discuss an exhibit of children's work in elementary science. This exhibit included charts in manuscript showing "Statement of the Problem; What We Did," and "What We Found Out." On a table below each set of charts was the science experi-

ment developed by the children. The exhibit also included some of the newest and best science resource materials.

In the next step, problems and activities in elementary science were planned. During the planning, consideration was given to the readiness, interests, and needs of children at various developmental levels, and to the integration of the problems and activities into the social studies framework.

Other counties in which science workshops have been conducted for the benefit of elementary school teachers are Alameda, Contra Costa, El Dorado, Kern, Lassen, Merced, Monterey, Sacramento, San Diego, Stanislaus, and Siskiyou. Workshops of this type were also reported by schools located in Alhambra, Compton, Fresno, Glendale, Long Beach, Los Angeles, and Richmond.

Curriculum Development Committees

Curriculum committees participate in the development of new elementary science courses of study, handbooks, and revision of existing guides. They also take part in the preparation of annotated elementary science bibliographies and lists of suitable audio-visual materials, science teaching bulletins, and descriptions of science concepts and activities which may be included in social studies units in varying degrees in different school districts.

A majority of the school districts and offices of county superintendents of schools from which data were obtained reported teacher participation in the development of the science curriculum. Examples of these reports follow.

> *Kern County:* We are, by means of a teachers' committee, developing a framework for science. The committee has been meeting for nearly a year and should have its job completed by June, 1952. This framework is outlined in the following sequence: science experiences; experiments and activities; materials and equipment; correlations; generalizations; textbooks and references. Many of the items included come from actual classroom work. An attempt is being made to develop the concepts by teacher study of the children and their questions. The desire is to locate the interests and needs of the children in the various grade levels.
>
> *Los Angeles County:* A curriculum committee in science, composed of selected kindergarten and primary teachers, will meet twelve Monday afternoons on released time during the remainder of the school year to work on the revision of the science portion of the course of study.
>
> *San Diego County:* An illustrated pamphlet on conservation education was prepared and published by the Curriculum Area Planning Committee for Science.

Stanislaus County: A curriculum development program is under way in which social studies, science, and health education are being integrated. This requires a great deal of study and actual development and testing of ideas in the classrooms, all of which promotes teacher growth. Among the teacher committees are science principles and concepts, unit development, resources and research, and course of study—broken into grade level subcommittees.

Pasadena: A specific aid to teachers is the recently published monograph entitled, *A Resource Guide in Science for the Elementary School*. This was prepared by a committee of teachers and central office personnel last spring and was distributed to each teacher at the opening of school this fall. The science material is organized into five areas: (1) living things, (2) earth, (3) space beyond the earth, (4) weather and climate, and (5) machines and energy. Suggested activities in each of these areas is organized separately by grade levels. The illustrations, poetry supplement related to science, and bibliographies all contribute to assisting the teacher in bringing science experiences to the children.

Grade level meetings during the current year have emphasized science experiences, charts, and suggestions for using the science monograph and the science kits.

San Francisco: To meet the science teaching demands in the public schools, the San Francisco public schools launched a science curriculum program which involved hundreds of teachers. Four of the teachers, selected for their interest and training in science visited the eighty-five elementary schools of the city to observe good science teaching and to interview outstanding teachers of science. The information gained from these visits served as a basis for the production of a series of three science teaching guides and for the selection of science supplies. Each guide covers two years of work. Each teacher has access to one of these guides and to the school's science kit for primary grades or science chest for intermediate grades. In addition, each primary room was furnished with flower pots and an aquarium.

Although the teachers possessed teaching guides and ready access to supplies, they still required a feeling of confidence. To meet this need, an in-service training program was launched with the co-operation of San Francisco State College.

In the future, the science guides will be revised in light of the experiences of the teachers using them.

Eureka: The first draft of a teacher's science guide was prepared by a committee of teachers last year. It is being edited now and will be placed in the hands of all teachers for a trial. Their reactions will be tabulated and an editorial committee will edit the guide before publication.

Groups of teachers, under the leadership of a naturalist, studied and listed local wild flowers and birds. The result of this study was a handbook of wild flowers and a list of birds found in Humboldt County during various seasons.

San Mateo: In the fall of 1947, a program was set up to improve and enlarge science teaching in the elementary grades. A steering committee, consisting

of a principal, a teacher from each school, the curriculum supervisor, and a science consultant was organized.

This committee has developed a series of science units and prepared such teaching materials as informational outlines, teacher guide sheets, pupil worksheets, suggested activities and experiments, and teacher direction sheets for each unit. Based on content desired by the teachers, the science consultant prepares and presents a fifteen-minute radio program each week over a local radio station. The pupils in the elementary schools have been prepared in advance for the programs which are broadcast into each classroom. Pupils have an opportunity to participate in programs which culminate each unit.

The preparation of source information outlines by the teachers, with the aid of the consultant, has resulted in a tremendous amount of teacher growth. In almost every classroom there is evidence of an interest in science activities.

Stockton: An elementary science curriculum committee has been organized to meet an expressed need for a guide to the teaching of elementary science. At the first meeting, several teacher problems were identified. Most of these problems related to what science should be taught and to effective ways of teaching science. The committee recognized the importance of the broader objectives of science teaching and were especially concerned with how children learn to solve problems.

Teachers were requested to submit descriptions of pupil experiences in science. A form was provided that would emphasize certain aspects of problem-solving such as question-provoking situations, problems identified by children, and solutions suggested by them.

Many excellent examples of ways teachers were using children's interests to provide worth-while experiences were submitted. The request also served to focus teacher thinking on problem-solving situations.

The committee then decided to collect examples of current good practices. They believed that if these could be grouped under broad areas, they would have one section of a guide that would help show the scope of elementary science, the variety of experiences that children can have, the relation of experiences to child maturity, and ways in which other teachers are utilizing resources.

This project is not completed. Limitations are readily apparent. Far too many teachers limit their science teaching to talking about and reading about science. Some teachers are reluctant to submit examples from their classes, and a school system with 450 elementary teachers is still a rather narrow base.

Fresno: An active Elementary Science Committee composed of elementary school teachers and principals with special interest and training in science has been organized. The Committee reflects the school administration's interest in promoting teacher preparedness and confidence for successful science teaching. It has endeavored to stimulate better science instruction by its work in the following areas: work on development of a course of study; exploration and recommendation of science materials and equipment for use in elementary schools; study and recommendation of policies relative to science instruction; workshops furthering in-service science education; preparation of materials for science units; and making use of stimulating science speakers.

Other school districts and the superintendents of schools for other counties are planning to organize science curriculum committees composed of classroom teachers.

Colleges and Universities Co-operate

A number of California colleges and universities co-operate with local districts by offering courses in science and science teaching methods for elementary school teachers. These courses are given on the campus in the late afternoon or evening or during the summer session. In certain cases they are given by extension in the local communities. Some of the courses are workshops in the true sense of the word; others use lecture-demonstration techniques for the most part. The instructors may emphasize science content, science teaching methods, or preparation of teaching guides and resource units.

A steering committee of the Redwood City elementary school teachers, for example, arranged for a science workshop course to be offered by San Jose State College. The committee indicated what the teachers would like the course to cover.

The California State Department of Education has encouraged the inclusion of science content and activities in the social studies or life experience units. As a result, many school districts request college workshop courses in which teachers may become familiar with instructional materials in both social studies and science. Occasionally, courses are organized around one socially significant area such as conservation or communication.

Use of courses in science for which college credit is granted as a part of the in-service education of elementary teachers was reported by the superintendents of schools in Contra Costa, Kern, Los Angeles, Plumas, Riverside, Sacramento, San Diego, Santa Clara, Siskiyou, and Stanislaus counties and by the superintendents of the school districts located in Alameda, Compton, Los Angeles, Pasadena, Redwood City, Richmond, Sacramento, and San Francisco.

The science staffs of the state colleges have for a period of twenty years played an important part in the improvement of science teaching in the elementary schools of California. They were largely responsible for the writing of the five-volume *Science Guide for Elementary Schools*[1] which has been distributed to every elementary school in the state.

[1] Science Guide for Elementary Schools, Vol. I-V. Sacramento: California State Department of Education, 1936.

At the present time science educators from a number of colleges are serving on the Science Committee of the California School Supervisors Association and on the California Council for Elementary Science. This issue of the *Journal* is one of the projects of the latter committee.

Other Services Provided

A wide variety of services other than workshops are provided by school districts and offices of county superintendents of schools in California for improving the science background of teachers and improving instruction in science in the elementary schools.

Study Trips

Well planned study trips with a definite purpose have long been recognized as one of the most functional techniques for teaching science. Many teachers, however, seem to be unaware of the potential values inherent in this type of activity. One way of overcoming their reluctance for taking pupils on trips is to provide stimulating excursions for teachers as a part of their in-service education. The leader of such trips shows where teachers may take the children, what they should show them, and what techniques are suitable for children of various ages.

The Los Angeles Public Schools provide opportunities for interested teachers to take "bird walks," seashore journeys, trips to the school animal center, and trips to study earth formations. Teachers in Trinity County have been especially appreciative of field trips to learn plant identification, and to study the forest, soil erosion, and soil types. These trips were organized and conducted by the supervisor of the Trinity National Forest and his staff.

A large number of elementary teachers in San Diego County have taken advantage of scenic flights on commercial airliners to study the local topography, geology, and geography. Community leaders often accompany the teachers on these trips. Folsom Dam and the Tracy Pumping Plant were visited last year by a number of teachers from Sacramento County. Groups of teachers in the Sacramento schools occasionally make trips that are conducted by the science supervisor or by members of the Audubon Society.

School camping programs such as have been developed by schools in San Diego and Santa Clara counties provide excellent in-service education experiences for the sixth grade teachers who accompany their pupils on a one-week visit to the camping area. The teachers, like the

children, have many worth-while experiences in nature study and conservation in this informal setting.

In some cases science field trips are conducted as a part of institute meetings. As mentioned earlier, they often form a part of in-service workshops and college science courses for elementary teachers.

Another form of study trip is the teacher visit. Teachers in the Alhambra Public Schools have found planned visits to other classrooms of particular value. Observation guides are used during the visit. Following each visit a conference is held between the visiting teacher and the teacher being visited.

Teachers' Meetings

The traditional, day-long institutes during which the teachers do nothing but listen to more or less inspirational and informational addresses, may still be found in California. In general, however, institutes have been modified to permit teacher participation. In these institutes a keynote address is now usually followed by a discussion period. Large audiences are often broken up into small groups to discuss the application of points made by the speaker to problems of particular import to the teachers.

Problem-centered meetings are often held after school, in the evening or on Saturday. Among the problems reported as being discussed at meetings of this type are room environment, choice and use of science textbooks, community science resources, care of plants and animals in the classroom, use of science films, point of view in science teaching, science in relation to social studies, science in relation to the California Framework,[1] grade level meetings to introduce new courses of study, implications for science teaching from our knowledge of child growth and development and preparation and presentation of science demonstrations.

Meetings are also frequently arranged to provide teachers with information in such areas of science as atomic energy, local plants and animals, conservation, electricity, and weather. Teachers in the Pasadena public schools have found "swap-shop" meetings with teachers in other schools located in Los Angeles County to be worth while. In sessions of this sort, teachers share their successful experiences in teaching science and exhibit charts, diagrams, and homemade science materials and equipment. They also help each other find the solutions to various problems which arise.

[1] *A Framework for Public Education in California.* Bulletin of the California State Department of Education, Vol. XIX, November, 1950. Sacramento: California State Department of Education, 1950.

Consultant Service

While only a few of the larger school districts and county superintendents of schools in the larger counties of the state provide full-time science supervisors or consultants for their teachers, nearly all have some staff member who is able to assist the elementary teachers with their science teaching problems. The superintendents of Kern, Los Angeles, and San Diego counties reported having full-time science consultants. In Santa Barbara County the audio-visual director is also a science specialist. Merced County has a part-time science consultant, and in Contra Costa County two general supervisors devote part of their time to assisting elementary teachers in science. The Sacramento, Stockton, Los Angeles, and Pasadena school districts are among those that employ science consultants on either a full- or part-time basis.

In addition to the regular supervisory staff, school districts in California often engage consultants on a temporary basis to assist in curriculum problems. Members of the science and science education departments of the state colleges have provided most of the temporary consultant service in the field of elementary science.

Several school districts have brought nationally known science educators to California to help their teachers. These educators have spent from one day to several weeks helping the teachers with their science problems. Among those who have made the circuit during the past year are Rose Lammel of New York University, R. Will Burnett of the University of Illinois, and Glenn O. Blough of the U. S. Office of Education.

Mention has been made of the use of science steering committees in consultant capacities. Certain school administrators are assigning teachers in such a way that each elementary school has one staff member who is interested in and capable of assisting other teachers with their science classes. This teacher may give demonstration lessons, have charge of science instruction materials, or just be someone that the teacher can run to with the snake that Tommy brought to school.

Instructional Aids in Science

Survey data indicate that the service most frequently provided by central office staffs of school districts for the improvement of science instruction is the preparation and distribution of bibliographies and lists of available audio-visual aids. A few county superintendents of schools and certain school districts have distributed science teaching bulletins prepared by members of the supervisory staff.

Before World War II most of the elementary science program in California was devoted to the study of living things, with perhaps a little astronomy and geology. During the past decade science educators have been urging teachers to capitalize on the natural interests of children in aviation, radio, electricity, weather, and other areas of their physical environment.

As the teachers gradually built up a background of basic concepts in physical science and received instruction in the preparation of simple demonstrations to illustrate and explain these concepts, they began to complain that they were handicapped because of the lack of materials and equipment needed for such demonstrations. Consequently, the school districts are beginning to provide materials not readily obtainable by teachers for use in carrying out their demonstrations and experiments. For example, in the San Francisco public schools science chests which contain such things as a microscope, magnets, wire, batteries, flasks, test tubes, chemicals, hot plate, and rubber stoppers are provided each school.

Commercial science kits similar to those provided the schools in San Francisco may be secured by school districts. These may be purchased for each school or, as in Stanislaus County, be housed in the audio-visual department of the office of the county superintendent of schools where they are checked out as they are needed.

The San Diego County Superintendent of Schools carried this idea a bit further. Portable kits have been developed using local community resources to provide instructional materials for use in some of the social studies-science units. For instance, the harbor kit includes such items as a floor map of the harbor showing locations of key industries and other points of interest; miniature lighthouses, ships, and buoys; and samples of products such as canned tuna which are produced by industries bordering the harbor. This kit provides a point of departure for construction, reading, writing, arithmetic, and other activities based on the harbor. Its use will prepare the children for an excursion to the harbor.

Another noteworthy service provided by the Curricular Services Division of the Office of the San Diego County Superintendent of Schools is the use of mobile shop equipment by teachers who wish to construct animal cages, simple electrical apparatus, weather instruments, and other science equipment. Four mobile units, manned by trained consultants in industrial arts, are available to the most remote schools in the county. These units contain both hand and power tools. Also a well-equipped elementary science laboratory is maintained for the teachers. The science

co-ordinator uses this room in helping teachers with individual problems and for conducting workshops with groups of teachers.

Problems of distance and transportation in large cities often make it difficult to take small children on study trips. The Los Angeles City School Districts are attempting to solve this problem by taking science to the school. Four large mobile science units travel daily to different schools in the districts. These units consist of large, custom-built trucks with stages and materials for science teaching. One truck carries a cow and calf, exhibits of dairy products, and equipment used to process the products. Another mobile unit deals with conservation of soil, water, forestry, and so on. A third unit carries wild animals found in California—an opossum, skunk, bobcat, and many birds and reptiles. The fourth truck carries small domesticated livestock.

Summary

The recent upsurge of interest in science education in California elementary schools has resulted in a demand for more adequate teacher education. A number of in-service training practices in the schools that are helping teachers to meet this demand have been described. These serve to point up the fact that science for every teacher is rapidly becoming a reality.

It was possible, because of space limitations, to describe in detail only a representative group of the desirable in-service practices that were reported. The writer wishes to express his appreciation and that of the California Council for Elementary Science to the many persons who provided information for use in this article.

SOME CHARACTERISTICS OF A GOOD SCIENCE PROGRAM [1]

JEFF B. WEST, *Co-ordinator of Audio-Visual Education and Supervisor of Elementary School Science, Stockton Unified School District, Stockton, California*

"Perhaps no area of study in the elementary school offers greater opportunity than does science for fully supplying so many of the needs of childhood." [2] That statement was made by Ralph Preston in the March, 1950, issue of *Childhood Education*. I would like to point out some of the ways that good science programs may contribute to the growth and development of children.

Young children are naturally inquisitive. Observation will show them constantly exploring their physical environment. This persistent curiosity of children in exploring their world, in discovering facts, and in finding out how things work indicates a readiness for learning that can be readily utilized in elementary education. In a good science program this readiness is utilized as a basis for introducing and developing each phase of instruction.

We know that curiosity is one of the strongest drives of childhood. We are aware that older children seem to be less curious than are younger children. In a midwestern city a study was made which revealed that the children in the first grade asked 65 per cent of the questions (the teacher asked 35 per cent), and that the children in the sixth grade asked 5 per cent of the questions—95 per cent were asked by the teacher. I believe the kind of school experiences offered children accounts for the existence of such a condition. Formal, teacher-dominated programs that leave no room for children to ask questions and to express their interests freely are not conducive to keeping alive the curiosity of boys and girls. On the other hand, the naive curiosity of children can grow into deeper intellectual curiosity through satisfactory participation in solving their own simple problems.

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[1] From a talk delivered by the author at San Francisco State College, May 17, 1952.
[2] Ralph Preston, "Using What We Know About Children in Developing Science Learnings." *Childhood Education*, March, 1950, p. 297.

Curiosity is essential to problem-solving. Problem-solving does not begin with ready-made problems selected from a list. It begins when children are faced with problem situations that they want to do something about. This implies that good science programs are to be found in stimulating classroom settings where teachers make use of trips, films, and other media to stimulate children's curiosity to the extent that they will be constantly discovering problems that they wish to solve. In other words, a good program is one that is rich in question-provoking situations.

When we are asked questions by children, our immediate reaction is to give an answer. Sometimes in giving answers we are guilty of going much further into detail than is necessary. Obviously, there are times when it is expedient for us to answer children's questions. But there are other times when a much better learning situation results if the teacher encourages children to suggest solutions, to gather facts and use them to determine solutions and to check the conclusions they formulate.

In suggesting solutions to problems, young children bring into play their imaginative impulses. Parents and teachers are well aware of this phase of children's nature. But in general they are not equally familiar with the fact that scientific thought and imagination are closely related. It was through imaginative thinking that radio, television, and the atomic bomb were made available. Naturally the first attempt of children at suggesting solutions will be crude; they will probably be only guesses. However, in the forty-sixth yearbook of the National Society for the Study of Education it is pointed out that "probably the most neglected skill in teaching problem-solving is the formulation of hypotheses." [3] This is a skill that must be developed just as other skills are developed. In the beginning, we should accept guesses from very young children, but as they mature we should insist on more reasoned judgments.

Rose Lammel says that "Solving problems through experimentation with science materials can help many children identify themselves and their way of working with the search for truth that has motivated scientific workers through the ages." [4] She illustrates this identification with the case of a girl in the seventh grade who had accepted, as her part in a group study of housing, the responsibility to demonstrate how a house could be heated by hot water and by steam. This girl was very creative in thinking out a way of using materials to demonstrate her ideas to the group. But difficulties ensued; the set-up leaked. After several seemingly

[3] *Science Education in American Schools*, Forty-Sixth Yearbook of the National Society for the Study of Education. Chicago: University of Chicago Press, 1947, p. 171.
[4] Rose Lammel, "Science Experiences Help Children Meet Their Problems," *Metropolitan Detroit Science Review*, September, 1951, p. 24.

unsuccessful trials, the teacher suggested that perhaps she had better give up the plan, but the girl would not hear of it. A day or so later, with several minor changes in the set-up the demonstration was successful. At the conclusion of the demonstration the girl remarked to the teacher, "Today I feel the way Pasteur must have felt when he came back and found the sheep he vaccinated hadn't died."

I am not proposing that elementary science become a series of formal exercises in problem-solving. However, the only way for children to learn to solve problems is to have opportunities to work on real problems that have some significance to them. I believe, too, that if children are to develop skill and interest in problem-solving that they must be provided an atmosphere of encouragement and approval in which to work. The role of the teacher in creating this atmosphere is an important one. Administrators, supervisors, and parents should understand the value of the program and express attitudes that reflect their approval of it.

The vocabularies of children when they first come to school have, for the most part, been built through firsthand experiences. After the children enter school they must adapt themselves to a situation where much of their learning will result from vicarious experiences. Such experiences should, however, be accompanied by real life situations when possible. A good science program is rich in possibilities for the use of such situations. In such a program children should have opportunity to build and arrange simple apparatus, manipulate objects, get information from films, filmstrips, books, and magazines.

Reading and discussing are acceptable science activities. So are observing and keeping records, constructing models, and experimenting. In far too many classrooms, however, children read about science and talk about science but never get a chance to do any of the other things that bring science to life.

A science program should offer opportunities for children to do considerable experimentation. The experimenting should, of course, be purposeful. Here is one way to test suggested solutions, or to find out for oneself that a statement is true or false. The best experiments to use are the simple ones suggested by children themselves. The ideal is to have children say, "I think if I do this, so and so will happen."

Not only is it important that science experiments be kept simple, but all science in the elementary school should be simple, should be concrete, and should be related to everyday topics. We should omit everything that is difficult, abstract, or remote. We must remember that the

elementary school is not the only contact children will have with science materials and phenomena. They will go on learning for many years, so we should not try to teach them everything at this level, for doing so will tend to destroy their interest in science.

The content for a science program for the elementary school can, for the most part, be selected on the basis of the needs and interests of children. But some caution should be exercised in doing so. Glenn Blough's story about the little second grade boy who had asked his teacher about penguins illustrates this point. The teacher felt that the boy had a burning curiosity that had to be satisfied so she got books from the library for him to study. The boy took one book to his table but after only a few minutes timidly placed it on the edge of the teacher's desk, saying, "This book tells me more about penguins than I want to know."

Pupil interest can be ascertained by paying close attention to persistent questioning by the pupils and by watching the behavior of the pupils who are asking the questions. If their interests seem to be trivial or narrow, it is the responsibility of the teacher to broaden them or to stimulate more worthy ones.

The areas selected for inclusion in the science program for the elementary school should be broad enough to permit each teacher to choose topics from it which the pupils in her group can study profitably. There must also be opportunity for the teacher to employ a variety of activities and provide adequate materials that the pupils can read. Each child must be recognized as an individual with his own interests, aptitudes, and limitations. At the same time, there must be developed a common interest so that children can get optimum value from sharing. In addition to content selected in terms of needs and interests of pupils, other content should be selected because of its importance in the community. I don't want to minimize the importance of functional concepts, but as Blough and Huggett point out, "The facts of science are important, but how these facts are put together in meaningful situations is far more important." [5]

In long term planning, it is important to make provisions that assure children well-balanced programs of experiences in science at each educational level. I shall discuss certain considerations concerning each of the six factors which are listed in the Forty-sixth Yearbook of the National Society for the Study of Education.[6]

[5] Glenn O. Blough and Albert J. Huggett, *Elementary School Science and How to Teach It.* New York: The Dryden Press, 1951, p. 13.
[6] *Science Education in American Schools, op. cit.,* pp. 72-73.

1. *Balance in terms of areas of environment*

   The yearbook groups experiences under six broad areas. The areas are titled Astronomy, The Earth, Conditions Necessary for Life, Living Things, Physical and Chemical Phenomena, and Man's Attempt to Control His Environment.

   Contrary to the belief that young children are interested only in living things while older children are more interested in physical phenomena, there is experimental evidence to show that children are interested in all aspects of their environment. Gerald Craig analyzed nearly 7,000 questions from children and found them to be well distributed over the various science fields. This means that a wide range of subject-matter may be pursued in a given year of school. Curriculum balance is attained by providing experiences in each of the broad areas rather than through fixed grade placement of topics.

2. *Balance in terms of areas of living*

   These are the familiar items of conservation of human and non-human resources, production, consumption, and distribution of goods and services.

3. *Balance in terms of time and space*

   At every grade level children need experiences which will help deepen their understanding of the immediate environment. At the same time they should have experiences that are in harmony with their maturity level and will extend their environment in both time and space. A well-rounded program will provide experiences with the "near" and the "far," and the "long ago" and the "now."

4. *Number and length of problems*

   Children need to participate in activities that involve a proper balance of short and long problems. Many problems which arise out of the daily living experiences of children may be solved satisfactorily within a short span of time. On the other hand, boys and girls need to solve problems which call for more extended planning and working than formulating solutions to these problems requires. The scope of long problems selected for this purpose should be suited to the children's needs, interests, and level of maturity. Care should be taken to prevent the problems from dragging out until the interest displayed by the children is exhausted.

5. *Balance throughout elementary-school period*

A school staff may co-operatively plan ways to insure balance and continuity in the elementary science program. Such planning should result in the development of a flexible science curriculum that the teachers can adjust to meet the interests and needs of the children in their classes. The curriculum should be revised continuously in light of teachers' experiences in using it with children and in evaluating the children's progress.

School administrators, supervisors, and teachers are faced with a problem of determining whether science should be taught as a subject or as an integrated part of larger curriculum areas. The solution that will be given for this problem depends in part upon their concept of broad problems. Certain educators interpret the framework set up in *The Social Studies Program for the Public Schools of California* [7] in such ways that it appears to be impossible to integrate science with the social studies and have the children attain the objectives of science. Others hold the opposite opinion. Whenever social areas are treated as primarily geographic, historical, or political, the problems that arise become so limited that children cannot have rich experiences in living or in problem-solving. One part of a sub-committee of the California School Supervisors Association studying the science curriculum met recently in Los Angeles. A week after that meeting another group met in Sonoma. At both of these meetings considerable discussion centered around the dangers that evolved as a result of the social studies framework being interpreted narrowly and how such an interpretation placed a major obstacle in the pathway of those who were interested in providing the elementary schools an effective science program.

Whether a definite time should be allotted for teaching science poses another problem that should be solved. Most science teachers believe that science should be taught at the time that opportunities for doing so present themselves. These may come during any part of the school day. On the other hand, one teacher expressed an opinion that probably represents that of other science teachers when she said, "If other subjects are to be listed in the daily program as reading, arithmetic, social studies, art, and music, I want them to list science too." Obviously, each teacher is responsible for providing rich experiences for the children in his group.

[7] *The Social Studies Program for the Public Schools of California.* Bulletin of the California State Department of Education, Vol. XVII, No. 4, (August, 1948). Sacramento: California State Department of Education, 1948.

Certain teachers are able to do this by a fusion of subject matter; others feel they can teach better if they provide separate science experiences and set aside a regular time for them. In my own school situation, we have both good teaching and poor teaching going on where science is taught as an integrated phase of the social studies and where it is taught separately.

I am going to close with this statement made by Glenn Blough. "Perhaps one of our next steps to improve science teaching is for science teachers to sit down and think—not about how to get more hours of science, more equipment, or a better fact test, but how to select science content and teach it so that it can make its greatest possible contribution to the all-round development of the girls and boys." [8]

[8] Glenn Blough, "Teaching More Than Science," *NEA Journal*, XXXVII (November, 1948), 515.

HOW CAN TEACHERS OBTAIN EQUIPMENT FOR ELEMENTARY SCHOOL SCIENCE?

ROBERT STOLLBERG, *Associate Professor of Science and Education, San Francisco State College*

Science is a body of knowledge—the facts, principles, and generalizations which mankind has developed and organized through the use of scientific methods and attitudes. This body of knowledge is often referred to as the content or subject-matter of science. In addition to being a body of knowledge, science is also a pattern of methods of thinking, of finding and using information, of modes of acting, and of tendencies to behave in certain ways. This pattern often bears such a sophisticated title as scientific methods or scientific attitudes. But, particularly in working with children, it is better to refer to this phase of science as the habits and skills of problem-solving, or of critical thinking, or as plain common sense.

The preceding point of view regarding the nature of science is vastly important to teachers, for it makes evident the fact that learning in the field of science involves both knowledge and scientific methods and attitudes. Stated somewhat more directly, science is investigational and experimental in nature. Learning in the field of science is sadly incomplete if confined to "learning the facts of science." The notion of "let's find out" and "try it and see" are characteristic of science and of good science education.

Teachers who subscribe to this broader point of view in science education find themselves less and less involved in the traditional pattern of textbook teaching. Indeed, each year they provide quite different learning experiences for their classes, because they realize that their pupils as well as the social and physical environment change from year to year. These enlightened teachers use the science text largely for reference purposes rather than as the basic guide for class activities. They also use encyclopedias, general reference works, and periodicals as sources of information for themselves and their pupils, and both teachers and pupils learn to seek and find desired information through personal interviews and correspondence, through excursions and deliberate observation, and

through experimentation. It is perhaps in this last respect that many elementary school teachers feel especially insecure and are in need of considerable help.

Teachers may provide opportunities for pupils to learn through experimentation either through conducting experiments or through observing teacher demonstrations of experiments. The accepted principle of learning by doing indicates that pupil participation is usually more desirable than pupil observation. But sometimes the nature of an experiment may require adult management, its complexity may demand mature skill in presentation, or elements of risk may dictate that it be kept out of the hands of children. In such cases, a teacher demonstration of the experiment may constitute the best means of providing children with the experience.

Learning through experiments, whether it be by pupil participation or by teacher demonstration, requires materials. Teachers who capitalize on the experimental characteristics of science find themselves working with plants and soil, construction materials and tools, animals and cages, scientific toys and apparatus and gadgets. Since most school systems do not automatically provide these, the teacher must take the initiative in acquiring them through purchase, construction, borrowing, and improvising. Under these circumstances, the teacher usually chooses to use one of the following solutions to the problem.

1. Purchases one of several commercially prepared kits for teaching elementary school science
2. Collects the materials through occasional purchase, borrowing, construction, and improvising
3. Decides that it "isn't worth the trouble" and returns to textbook teaching

The remainder of this article is devoted to a consideration of the advantages and disadvantages of the first two of these choices and to suggestions for implementing each.

Some public school systems, such as that of San Francisco, provide science teaching kits of their own design for the elementary schools. Several commercially prepared kits, designed specifically for elementary school science teaching, are on the market. Three of these are

PORTA-LAB—Acme Educational Laboratories, 119 East 17th Street, New York, N. Y.

SCIENCE KIT—204 Dexter Street, Tonawanda, New York.

STANSI SCIENCE KIT—Standard Science Supply Company, 1231 North Honore Street, Chicago 22, Illinois.

These three products resemble each other in several respects. Their prices are similar (from $33.00 to $41.50, currently), and, in general, the major items in the kits are similar. The following items are usually included in the science kit:

alcohol lamp and candles (sources of heat and light)
ring stand or tripod stand (support for apparatus)
a few assorted heat-resistant beakers and flasks
test tubes, medicine dropper, test tube rack
funnel and/or thistle tube
rubber stoppers, rubber tubing, glass tubing
a few common chemicals
litmus paper, limewater
thread, paper clips, pins, rubber bands
spring balance
pulleys and string
balloons, table tennis ball
tuning fork
glass prisms
magnifying glass and other lenses
mirror
horseshoe magnet, bar magnets
iron filings
magnetic compass
dry cells
knife switches
miniature lamps and sockets
insulated copper wire
electric doorbell or buzzer
pith balls
glass and/or plastic rod

Each of the kits comes in a sturdy chest or cabinet designed for permanent storage. In at least one instance, the supplier will sell the contents without the chest. Each of the three kits includes a manual of instruction which describes many experiment demonstrations. The manual is planned for use with the kit but usually it can be purchased separately.

Much can be said in favor of the practice of depending on a commercial kit as a source of materials for conducting experiments; also much can be said against the practice. A commercial kit may be satisfactory for certain schools and unsatisfactory for others. Likewise, some schools may find it feasible to collect their own materials locally; other schools may find this practice unsatisfactory. Still others may need both a commercial kit and a local collection. A comparative study of the materials contained in a commercial kit with those that are generally collected in local situations should therefore prove helpful to those responsible for securing the materials that are necessary to give pupils adequate opportunity to conduct experiments and for teachers to make the demonstrations that are desirable.

Advantages of Commercial Kits

Commercial kits for elementary school science have several advantages. In the first place, commercial kits are easy to buy. Obtaining a commercial kit is as easy as writing out a single order (and paying the bill). In ordering the commercial kit, the teacher need not select and buy equipment with which he is unfamiliar. The only delay between making the decision to buy the kit and using it in teaching is the delivery time. In some situations, this may be only a matter of hours.

A second advantage of commercial kits is that they are designed by experienced persons. The items included are of good quality and are selected so as to permit a maximum number of science experiences.

Commercial kits also include a chest for storage. Elementary school teachers almost invariably have difficulty finding space for storing equipment and materials. This difficulty is considerably eased by the convenient portable storage chest provided with commercial kits. The storage chest is particularly useful in transporting science materials from room to room or from building to building.

Another advantage of the commercial kit is that each of the commercial kits mentioned here includes a manual of instruction. This is intended to help the teacher perform experiment demonstrations or to help the pupils perform them individually or in small groups.

Advantages of Collecting Science Materials Locally

There are several advantages that may be gained by collecting locally materials for teaching science. In the first place, local collections can be adapted to local needs. In collecting materials locally, teachers can adapt their collection to pupil needs and interests, teacher objectives, and incidental equipment already on hand. Thus, if pupils are particularly interested in electricity, the collection can emphasize materials that can be used in teaching this subject. If a school has on hand such items as candles, lenses, prisms, colored cellophane, or gelatin, these items may also be used. Such items are usually duplicated if a commercial kit is purchased.

Another advantage is that local selections can include a reasonable amount of life science materials. Commercial kits for elementary school science typically emphasize physical science to the extent that life science materials in many cases are excluded. This practice probably results from the fact that the cost of shipping seeds, soil, flower pots, animal cages, and the like all over the nation is great; many materials for elementary school life sciences are already on hand or readily available locally, and the

belief that, in general, elementary school teachers need more help in the area of physical science than in that of life science. Although there is reason for this unbalanced condition, it nonetheless constitutes a weakness of the typical commercial kit. On the other hand, collections that are made locally will not have this weakness, providing they are made intelligently. To put it another way, it is quite possible that inexperienced teachers using commercially prepared kits may give too great an emphasis to physical science or that those using locally purchased, borrowed, homemade, and improvised materials may veer in the opposite direction unless the local collections are made under the guidance of teachers who are informed in the field of science education.

Another advantage of local collections is that they can emphasize simple, familiar materials. Many simple scientific facts can be learned through experiences involving common items about the school and home. Screen door springs, medicine droppers, modeling clay, rubber bands, flashlights, balls of all kinds, balloons, roller skates, silverware, toys, tools, and musical instruments are but a few examples of readily available materials that are useful in elementary school science. Of course, many occasions arise when scientifically designed equipment is highly desirable. When needed, such items as heat-resistant glassware, rubber and glass tubing, test tubes, rubber stoppers, thermometers, litmus paper, and a powerful magnet are indispensable items. Specialized apparatus should be available for use when it is needed. But the practice of using unfamiliar, often grotesque, equipment when it is not needed should be avoided.

Much can be said in favor of using simple, everyday materials whenever possible. The cost of such materials is reasonable and the materials are usually available. Moreover, every piece of strange apparatus is an obstacle in the path of the learner. The mere presence of the unfamiliar, sometimes bizarre, apparatus may distract the attention of the pupil from the principle of science under consideration. Most important of all, perhaps, is the effect of commercial science equipment on the learner's concept of the role of science in daily living. Highly complicated apparatus for conducting experiments may tend to cause pupils to think that science itself is only for specialists—is strictly a laboratory subject. This is contrary to the accepted practice of teaching childen that science is an everyday matter, something they constantly encounter, use, and enjoy in the daily walks of life. Accordingly, it is clear that teachers should strive, when possible, to teach science with materials encountered at home, at

work, at play. If possible, a milk bottle should be used instead of a special flask; a soda straw instead of glass tubing.

One of the seldom mentioned advantages of local collections of material for elementary school science is the rich educational experience provided the collectors. If the class makes its own collection of materials, it would plan carefully, drawing on as many sources or using as many suggestions as possible. For example, one committee might study a science text or a collection of science experiments to see what is needed, while others might consult experienced teachers, examine high school science laboratories, or read literature pertaining to elementary school science materials.

The group should have a small fund for the materials it needs to collect. The fund should be properly budgeted. When money is spent, receipts should be secured, and accurate financial records should be maintained. The pupils should first secure items from attics, junk yards, and similar repositories of discarded material. They should then purchase the other material needed. Much apparatus could be constructed and improvised by pupils. As the collection began to take shape, pupils could develop facilities for display and storage of tools, equipment, materials, and specimens. Properly guided, such a class project might continue many months, perhaps almost indefinitely.

The procedure suggested is rich in possibilities for desirable learning experiences. Purposeful planning, democratic group action, seeking and using information, delegation and acceptance of responsibility, carrying on correspondence, budgeting of real money, seeking best purchase values, keeping genuine records, practice in manual skills, development of resourcefulness and ingenuity, care of community property—all these and many other worth-while activities can be part of the experience of pupils whose teacher stimulates a project of locally collecting elementary school science materials.

Of course, this procedure requires effort to be put into practice. Much time and energy of pupils is involved, as is much thought and guidance of the teacher. But the pupils' experiences result in desirable learnings, and the teacher's thought and guidance enhances the education of children.

FREE AND INEXPENSIVE SCIENCE MATERIALS FOR THE ELEMENTARY TEACHER

MORROW F. STOUGH, *Assistant Professor of Education, San Diego State College*

An ever-increasing supply of usable materials is available to teachers of elementary school science. This material is offered by business and industrial organizations, hobby and special interest groups, and local, state, and national agencies. Much material has been produced recently that, in general, is of higher quality than materials produced earlier. This improvement in quality has resulted from the efforts of groups such as business and industrial organizations and the National Science Teachers Association.

Supervisors in teacher education institutions and in field service are encouraging and helping teachers to make a collection of usable science materials. Such collections can be made at nominal cost, providing they are made wisely. The author obtained without cost one copy of most of the materials listed in this article. Yet the information gathered from reading the *Story of*— type of pamphlet and the biographies of famous scientists, to name only a few, has been worth the price of several books.

TYPES AND SOURCES OF MATERIAL

Classes interested in animals can secure from dairy commissions, breeders' associations, local museums and zoos, sellers of bird seed, Audubon clubs, state fish and game commissions almost everything from large pictures and posters to excellent factual materials. Those wishing to study plant life can secure materials from groups interested in preserving wild flowers and trees, garden clubs, producers of cereals and other foods, agricultural agents, and private and governmental agencies interested in conservation. In the area of conservation, the sources and types of teaching aids are endless. Whether the problem involves a study of soils, forests, or minerals, private and governmental agencies are ready with information, each encouraging conservation practices in turn and each giving its interpretation of the facts.

A great deal of material such as pamphlets, posters, teaching units, and films dealing with the original sources of plastics, rayon, paint, and aluminum can be secured for a small charge or free by merely requesting it.

In short, in almost every area of the elementary science curriculum the teacher can receive valuable aid at little cost.

Using the Materials

Although many of the packets available contain material that can be read only by pupils in the intermediate grades and above, teachers at the primary level can find some uses for the materials in them. For example, packets from breeders' associations contain pictures that may be used in the primary grades—a milk cow, a large pig. The reading material on the improvement of breeds would be appropriate for pupils in or above the intermediate grades.

In the fields of health, safety, nutrition and foods, excellently illustrated materials include simple posters and charts. Activities of primary children are frequently employed in this material as centers of interest.

For those using the pamphlets of business and industry, several suggestions may be offered. Teachers at all levels will find many excellent ideas for bulletin boards showing the various uses of our common, and, in some cases, dwindling resources. The pictures of men and machines at work are of interest to every elementary school child.

Many of the business-sponsored teaching aids are centered about a *Story of*— theme. Such material should be of value to a teacher who is concentrating on conservation, the contribution of research and invention to everyday living, and similar topics. In studying these materials, children learn that many present-day conveniences can be traced to the soil, to plant and animal life—in short, to a simple, common source. They also acquire understanding and appreciation of the fact that things in their immediate environment which they tend to take for granted have been obtained through the ingenuity and hard work of many people. Pictures show people at their jobs. Since both boys and girls are interested in people and the work they do, they should be given opportunity to learn from these pictures the contribution each person makes toward making the world increasingly livable.

Finally, the *Story of*— booklets describe the way in which man has employed the methods of science to improve his way of living. Often this progress develops from the achievements of men whose lives are an

inspiration to the young. Girls and boys are thrilled to relive an outstanding discovery with the inventor. These booklets provide them such opportunity.

Materials Available

Lists of instructional materials that can be secured free or at small cost are contained in the following publications:

Elementary Teachers' Guide to Free Curriculum Materials. Randolph, Wis.: Educators' Progress Service.

Free and Inexpensive Learning Materials. Nashville, Tenn.: Division of Surveys and Field Services, George Peabody College.

Sources of Free and Inexpensive Teaching Aids: A Source List. Riverside, Calif.: Bruce Miller, Superintendent of Schools.

References for Teachers

In the following list are catalogues, pamphlets, books, posters, and charts that will be of help to teachers in elementary school science.

General

Aids to Education. Detroit, Mich.: General Motors Corporation, Department of Public Relations (3044 West Grand Boulevard).

A catalogue of educational materials and equipment available to schools. Booklets in the list may be obtained without charge.

Information Pamphlets. Hollywood 28, Calif.: W. Scott Lewis (2500 North Beechwood Drive).

A set of seven pamphlets. Each gives pertinent facts on western trees, rocks, desert plants. Data is designed to accompany slides. Prices range from 15 to 50 cents.

Little Wonder Books. New York 19, N. Y.: American Education Press, Inc.

A series of almost one hundred booklets, written for all elementary grades, covering all phases of elementary science. First digit of the booklet number specifies the grade level. Price 20 cents.

Packets of Pamphlets. Washington 6: National Science Teachers Association (1201 Sixteenth St., N. W.).

An NSTA membership service. Packets of selected business-sponsored material are sent periodically. Eighteen have been issued thus far. Back issues are not available. A bibliography of the pamphlets will be sent with early orders. Special membership rates for elementary schools.

Parker, Bertha Morris, and Blough, Glenn O. BASIC SCIENCE EDUCATION SERIES. Evanston, Ill.: Row, Peterson and Co. (1911 Ridge Ave.).

Inexpensive booklets covering all areas of elementary science. Graded, well illustrated. Price 35 cents.

SCHOOL NATURE LEAGUE BULLETINS. New York 28, N. Y.: National Audubon Society (1000 Fifth Ave.).

Four-page bulletins, 8½ by 11 inches, covering many natural history topics. Attractively illustrated in popular style. Bibliography in each. Price 10 cents.

Teaching Aids and Motion Pictures. Pittsburgh 30, Pa.: Westinghouse Electric Corporation, School Service (306 Fourth Ave., Box 1017).

TURTOX SERVICE LEAFLETS. Chicago 37: General Biological Supply House, Inc. (761 East 69th Place).

Each leaflet contains four pages of pictures, diagrams, and helpful information. An excellent resource for the teacher; easy to file. Leaflet index is available. Among others, elementary teachers can use Numbers 1, 2, 3, 5, 7, 10, 11, 13, 18, 23, 24, 25, 28, 29, 34, 35, 38, 40, 45, 46, 47, 48, 49, 50, and 53. Price, each leaflet, 1½ cents.

CONSERVATION

America's Strength Grows in Her Forests. Washington 6: American Forest Products Industries (1319 Eighteenth St., N.W.).

A teachers' manual, suggesting ways of adapting forestry materials and information for use in social studies, language arts, and arithmetic. Useful, with two booklets available in quantity, *Trees for Tomorrow* for Grade 6 and up, and *The Story of Forests* for Grades 4 to 8.

California Teachers' Bibliography. San Fernando, Calif.: U. S. Department of Agriculture, Soil Conservation Service, Box 790

Lists books, pamphlets, audio-visual aids for the teacher. Annotated.

Let's Save Soil with Sam and Sue. Washington 25: U. S. Department of Agriculture, Soil Conservation Service, 1951. Price 30 cents.

Making Land Produce Useful Wildlife. Farmers' Bulletin No. 2035. Washington 25: U. S. Department of Agriculture, Soil Conservation Service, 1951.

Stresses balance in nature which exists on every farm. Suggestions on managing drainage ditch banks, fence rows, odd area, pond. Has pictures and diagrams. Price 15 cents.

Model Oil Field Project. San Francisco 20: Standard Oil Co. (225 Bush St.).

A kit of materials for constructing an oil derrick and all the workings.

Outlines for Teaching Conservation. Portland, Ore.: U. S. Department of Agriculture, Soil Conservation Service.

Prepared by the Education Section, Soil Conservation Service. Available for urban and rural elementary schools. Cites grade level objectives, activities, references.

PACKET OF MATERIALS. San Francisco 11: U. S. Forest Service (630 Sansome St.).

Treats facts about forest farming, water, work of the forest service, including charts, bibliographies, and teaching suggestions.

School Bibliography and Educational Materials on Forestry and Forest Products. Washington 6: American Forest Products Industries (1319 Eighteenth St., N.W.).

Excellent source of free materials including posters, booklets, and films.

Soil Defense in the Pacific Southwest. Farmers' Bulletin No. 1848. Washington: U. S. Department of Agriculture, Soil Conservation Service, 1940.

Good study of soil conservation measures. Applies to California and Nevada. Pictures usable at intermediate and upper levels.

Sulphur and Soils. Houston 2, Texas: Texas Gulf Sulphur Co., Agricultural Department (911 Second National Bank Bldg.), 1950.

Will help sixth graders and the teacher to see sulphur as a food element and a fertilizer. Other interesting pamphlets available from the same source.

Teaching Conservation in Elementary Schools. Bulletin 1938, No. 14. Washington 25: U. S. Department of Agriculture, 1940.

May be obtained from Superintendent of Documents, U. S. Government Printing Office. Filled with suggestions for understandings to be achieved, things to do, and bibliographical material. Price 20 cents.

Visual Materials on Soil and Water Conservation. Washington 25: U. S. Department of Agriculture, 1951.

Lists films, describing them, including a summary of the story, educational content, and suitability for grade level.

Walker, E. D., and Foster, A. B. *This Is Our Soil.* Danville, Ill.: The Interstate Printers and Publishers, 1951.

A large picture and simple text explain one important idea on each page. Pictures for all grades; text for upper grades. Ten pages of suggestions for activities and experiments.

Waste Not, Want Not. New York 20: Shell Oil Co. (50 West 50th St.).

Conservation in petroleum production, refining, and consumption. Modern methods of handling petroleum, gas, and water found together in the earth.

What Is Soil Erosion? Miscellaneous Publication No. 286. Washington 25: U. S. Department of Agriculture, 1938.

Outstanding for helping teachers understand this vital problem. Pictures for many grade levels. Considers all types of erosion. Price 15 cents.

FAMOUS SCIENTISTS

Edison and His Electricity. Schenectady, N. Y.: General Electric Co., 1950.

The principal events in Edison's life. For upper grades.

Famous Names in Chemical History. Corning, N. Y.: Corning Glass Works.

Titles include: *Banting, Priestly, Lavoisier, Cavendish, Pasteur, Dalton, Nieuwland.* For Grade 6 and up.

Thomas Jefferson, Soil Conservationist. Miscellaneous Publication No. 548. Washington 25: U. S. Department of Agriculture, Soil Conservation Service, 1944. Price 10 cents.

For upper grades. A story of the conservation efforts of a famous citizen.

HEALTH, SAFETY, NUTRITION

Children's Safety Lessons. Chicago 40, Ill.: Lumbermen's Mutual Insurance Co.

For primary grades. Story, pictures to be colored, and songs. Large posters of each picture for the teachers.

The Human Ear. Elmsford, N. Y.: Sonotone Corporation.

Two well-illustrated charts, 27 by 30 inches. Good explanation of the structure of the ear and how we hear. Smaller prints for pupils.

Nutrition Education. Minneapolis 1, Minn.: General Mills, Education Section.

A wealth of material including a Teacher's Guidebook containing background data, pupil activities, good references. Also readers for primary grades, teaching posters, parent leaflets, films.

Safety Posters. New York 7, N. Y.: National Board of Fire Underwriters (85 John St.).

Assorted posters emphasizing fire drills, dangers from electrical wiring and appliances, and burning cigarettes.

SCHOOL HEALTH PUBLICATIONS AND FILM STRIPS. San Francisco 2: Metropolitan Life Insurance Co. (Pacific Coast Head Office, 600 Stockton St.).

These materials have been developed especially for the elementary school.

Working Together for Better Dental Health. New York 20: Educational Service Department, Bristol-Myers Products Division (45 Rockefeller Plaza).

An excellent unit containing graded teaching for use in primary and intermediate grades. Includes wall chart, toothbrushing model, and manual.

MATTER AND ENERGY

ADVENTURE SERIES. Schenectady, N. Y.: General Electric Co.

A series of nine booklets in comic book style for upper grades. Topics include electricity, jet propulsion, and atomic energy.

How Does It Work? Pittsburgh 30, Pa.: Westinghouse Electric Corporation (306 Fourth Ave., Box 1017).

Comic book pictorial giving simple facts about atomic power, jet propulsion, electricity, radio, and television.

How to Build an Electric Motor. Pittsburgh 30, Pa.: Westinghouse Electric Corporation (306 Fourth Ave., Box 1017).

Short history of the electric motor and how it works. Simple directions.

The Incandescent Light. West Orange, New Jersey: Thomas Alva Edison Foundation, Inc., 1949.

First in a series covering Edison's inventions. A gold mine for teachers.

The Inside Story of Dry Batteries. New York: National Carbon Co., 1943.

A guide for pupils. Begins with fundamental principles of electricity applied to batteries. Considers operation and construction. Good illustrations.

LLEWELLEN, JOHN. *Primer of Atomic Energy.* Life Adjustment Booklet. Chicago 10: Science Research Associates, Inc. (57 West Grand Ave.).

Covers the characteristics of atomic energy and atomic weapons for peace-time use. An instructor's guide. Written for Grades 7 to 12. Price 40 cents.

Optics and Wheels. Detroit 2, Mich.: General Motors, Department of Public Relations.

A story of lighting from torches to tungsten. Explanation of the qualities of light, the prism, refraction, a mirage.

Power Goes to Work. Detroit 2, Mich.: General Motors, Department of Public Relations.

A nontechnical discussion of how power is used to drive an automobile, an airplane, and a boat. Begins with the simple machines such as the lever, wheel, and pulley. For Grades 5 and 6 and up.

The Use and Care of the Microscope. Rochester 2, N. Y.: Bausch and Lomb Co.

Treats the theory, manipulation, and care of the instrument. A fine companion booklet, *Milestones in Optical History,* with full-page colored paintings, depicts thirteen important scientific discoveries in the field of optics.

PLANTS AND ANIMALS

Birds and Animals of Australia. New York 20: Australian News and Information Bureau (636 Fifth Ave.).

Large chart and booklet describing kookaburra, koala, platypus, and others.

Brown Swiss, the Farmer's Cow. Beloit, Wis.: Brown Swiss Cattle Breeders Association.

Outlines characteristics, origin, development, importation to and growth in America. Illustrated.

"Chart on Sugar." New York 5, N. Y.: Sugar Information, Inc. (52 Wall St.).

A large colored chart using clever illustrations to describe the process of photosynthesis. Shows sources and uses of sugar.

The City of Bees. Medina, Ohio: A. I. Root Co.

Life inside a hive. Miniature booklets treat of building an apiary, producing comb honey, bees, and fruit.

A Handbook on Rabbit Raising. Circular 161. Berkeley 4, Calif.: California Agricultural Extension, College of Agriculture, 1950.

The feeding of rabbits, building of hutches, care and handling. Illustrated.

How to Collect and Mount Insects. Urbana, Ill.: Illinois History Survey, Natural Resources Building.

A large, free, helpful booklet.

How to Make an Insect Collection. Rochester 9, N. Y.: World's Natural Science Establishment, Inc. (Box 24, Beechwood Station).

An improved revision of an excellent booklet. Price 25 cents.

PAMPHLETS ON WESTERN PINES. Portland 4, Ore.: Western Pine Association (Yeon Building).

A set of ten 4-page pamphlets presenting facts about familiar western pines. Gives botanical classification and uses. Illustrated with pictures of houses and wood products.

School Gardengrams. Columbus, Ohio: National Garden Institute (1368 North High St.).

Four-page pamphlet sent monthly on request. Suggestions for activities and experiments. Illustrated.

SCHOOL WILDLIFE LEAFLETS. Sacramento 14, Calif.: California Department of Fish and Game. Distributed to schools by California State Department of Education.

Four-page leaflets written for fifth grade and up. Illustration in color on front page of each leaflet. Titles: No. 1, *The California Valley Quail;* No. 2, *Trout of California;* No. 3, *Salmon of California;* No. 4, *The Beaver;* No. 5, *The Striped Bass;* No. 6, *Deer of California;* No. 7, *Abalone;* No. 8, *Mallard Ducks;* No. 9, *Yellowfin Tuna;* No. 10, *California Black Bear;* No. 11, *The Gray Squirrel;* No. 12, *The Ringneck Pheasant;* No. 13, *The Sardine.* Others in preparation.

The Story of the Redwood. San Francisco, Calif.: California Redwood Association (405 Montgomery St.).

Facts of the California Redwood industry. Tells uses of redwood.

Your Aquarium. Philadelphia 7, Pa.: Innes Publishing Co., 1950.

Brief, clear directions for keeping fish and plants healthy. Price 25 cents.

PRODUCTS AND PROCESSES

The A B C's of Aluminum. Louisville 1, Ky.: Reynolds Metals Co., 1950.

In simple, nontechnical language tells of the discovery of aluminum, its properties, and its uses. Pictures typical fabricating operations.

The Automobile Story. Detroit: General Motors Corporation, Public Relations Department (3044 West Grand Blvd.).

Contains teaching units for primary, intermediate, and upper grades.

The Bituminous Coal Story. Washington, 5: Bituminous Coal Institute, Educational Department (Southern Building).

A 16-page color booklet discussing the history of coal, kinds of mines, modern production methods, safety measures, and new uses for coal for Grades 4 to 5 and up. Booklet on free teaching aids upon request.

The Magic of Communication. Pacific Telephone and Telegraph Co., 1951.

Explains how the telephone works; with diagrams. May be obtained from nearest business office of the telephone company.

The Making of Steel. New York 1, N. Y.: American Iron and Steel Institute (350 Fifth Ave.), 1950.

Information gathered over a period of twelve years about making coke, tinplate, steel wire, tool steels, and tin cans. Illustrated with photographs and diagrams.

PACKET OF MATERIALS. Memphis, Tenn.: National Cotton Council of America, Box 18.

Contains charts and descriptive material which will furnish background for a conservation theme. Good picture stories of men and machines at work.

PACKET OF MATERIALS. Los Angeles 14: United Air Lines, School and College Service (Sixth and Olive Streets).

Contains a study of the important parts of the Mainliner 300. A 6-page descriptive folder for pupils. Available in quantity; also a list of free aviation education materials and sources.

Paper—Its Story. San Francisco, Calif.: Crown-Zellerbach Corporation (343 Sansome St.).

A French scientist observing wasps construct nests of chewed wood concluded that paper could be made from wood. Describes complete paper-making process.

The Romance of Leather. New York, N. Y.: Tanners' Council of America (100 Gold St.).

Highlights on the historical development of the use of leather. Useful in a study of pioneer life. The story of hides is simply and clearly explained. Two-reel film also available.

Science Creates a Modern Industry. New York 1, N. Y.: American Viscose Corporation, Consumer Service (350 Fifth Ave.).

A free teaching unit on rayon. Booklets 1 cent each. Titles: *The Clothes I Wear,* Grades 1 to 3; *Man-made Miracles,* Grades 4 to 8. Accompanying films.

The Story of Evaporated Milk. Chicago 1, Ill.: Evaporated Milk Association (307 North Michigan Ave.).

Explains many scientific processes—evaporation, condensation, sterilization, homogenization. Suggests experiments for upper grades and gives references. Posters available. Twelve-page comic strip for the lower grades.

The Story of Petroleum. New York, N. Y.: Shell Oil Company (50 West Fiftieth St.).

Summary of the origin, exploration, production, and refining of petroleum. Cartoons cleverly illustrate petroleum facts.

The Story of Rubber. Akron, Ohio: B. F. Goodrich Co.

For grade and junior high school levels. Packet contains a teacher's manual and companion booklet, Wonder Book of Rubber. Includes objectives, activities, culmination.

Time Telling. Lancaster, Pa.: Hamilton Watch Company, Educational Department.

Interesting facts on what makes a watch run, its importance in our lives. Large chart and 4-page lesson sheet included.

WEATHER

A to Zero in Refrigeration. Detroit 2, Mich.: General Motors, Department of Public Relations, 1950.

A nontechnical story of how a refrigerator works. Clever illustrations of the science of heat and cold.

WEATHER PACKET. Washington, 25: U. S. Department of Commerce, Weather Bureau.

Pamphlet titles: *Cloud Forms,* price 10 cents; *Weather Forecasting,* 15 cents. A sample daily weather map and chart of weather symbols will be sent free. Copies in bulk, 2 cents each.

Weather Series for the Amateur. Rochester 1, N. Y.: Taylor Instrument Companies.

Topics include humidity, thermometer, barometer, and compass. Price 25 cents each pamphlet.

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